Honeywell

UDC 5000
Universal Digital Controller
Product Manual

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Rev. E

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About This Publication

How this manual is organized

This Product Manual is divided into 12 sections. These sections contain all the information you need to configure, operate, monitor, and troubleshoot your controller.

To find information quickly, use the comprehensive Table of Contents in the front of the manual and the Index located in the back of the manual.

Warranty

The device described herein has been manufactured and tested for correct operation and is warranted as follows:

> The UDC5000 Universal Digital Controller carries a two year warranty. This warranty includes immediate technical assistance via a toll free telephone number and complete replacement of the controller, if necessary.

Technical Assistance

If you encounter a problem with your UDC5000 controller, review all the configuration data under the Set-up groups to verify that your selections are consistent with your application; i.e. Inputs, Outputs, Alarms, Limits, etc.

If the problem persists after checking the above, you can get technical assistance by dialing

1-800-423-9883	USA
1-800 461-0013	Canada

An engineer will discuss your problem with you. Please have your complete model number, serial number, and Software version available.

The model and serial numbers can be found on the chassis nameplate. The software version can be viewed under Setup Group "Status." See *subsection 9.4*.

If it is determined that a hardware problem exists, a replacement controller or part will be shipped with instructions for returning the defective unit.

Do not return your controller without authorization from Honeywell's Technical Assistance Center or until the replacement has been received.

Symbol Definitions

⚠	This **CAUTION** symbol on the equipment refers the user to the Product Manual for additional information. This symbol appears next to required information in the manual.
⚡	**WARNING,** risk of electric shock. This symbol warns the user of a potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 Vdc may be accessible.
⏚	Protective earth terminal. Provided for connection of the protective earth (green or green/yellow) supply system conductor.

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Acronyms

EMI	electromagnetic interference
HID	high intensity discharge
MOVs	Metal Oxide Varistors
NC	normally closed
NO	normally open
PID	Proportional, Integral, and Derivative
RC	resistance-capacitance
RFI	radio frequency interference
RH	Relative Humidity
RTD	Resistance Thermometer Device
SCRs	Silicon controlled rectifiers
UDC	Universal Digital Controller

Parameters

A1S1 VAL	Alarm 1, Setpoint 1 Value
A1S1TYPE	Alarm 1, Setpoint 1 Type
A1S1 HL	Alarm 1, Setpoint 1 State
A1S2 VAL	Alarm 1, Setpoint 2
A1S2TYPE	Alarm 1, Setpoint 2
A1S2 HL	Alarm 1, Setpoint 2 State
A2S1 VAL	Alarm 2, Setpoint 1
A2S2TYPE	Alarm 2, Setpoint 2 Type
ACTION	Control Output Direction
ADAPTIVE	Autotune Type
AL HYST	Alarm Hysteresis
ASTP	automatic step change
AT ERROR	Autotune Error codes
AUTO	Lower display automatically displays setpoint value in engineering units
AUX OUT	Auxiliary Output Option
BAUD	Baud Rate
BIAS IN1	Input 1 Bias Value
CAL TEST	Calibration test failure
Com ADDR	Communications Station Address (Loop 1) RS422 or DMCS
Com ADDR2	Communications Station Address (Loop 2) RS422 or DMCS
ComSTATE	Communications Option State
CONF ERR	configuration error
CONFTEST	Configuration data in controller in error
CONT ALG	Control Algorithm
CYC SEC	Cycle Time
CYC2 SEC	Cycle Time 2 (Cool)
DEADBAND	Output Relay Deadband
DIG IN 1	Remote Switching 1 selections
DROPOFF	Controller Dropoff Value
E E FAIL	Unable to write to non-volatile memory
END SEG	End Segment Number
FACT CRC	Factory Calibration Cyclic Redundancy test
FAILSAFE	Controller in Failsafe
FILTER 1	Input 1 Filter
FILTER2	Input 2 Filter
FINAL SP	Single Setpoint Final Setpoint
GAIN	Gain
GAIN2	Gain 2

Parameters

IN1 HI	Input 1 High Range Value
IN2 HI	Input 2 High Range Value
IN1 LO	Input 1 Low Range Value
IN2 LO	Input 2 Low Range Value
INP1 RNG	Input Out of Range
INP1FAIL	Two consecutive failures of Input integration
KPG	Process Gain Value
LOCKOUT	Configuration Lockout
LOOPBACK	Local Loop Back
MAN	Lower display automatically indicates output in %.
MAN RSET	Manual Reset
MINorRPM	Reset Units
MSTP	manual step change
OUT HYST	Output Relay Hysteresis
OUT LOLIM	Low Output Limit
OUTHILIM	High Output Limit
OUTLOLIM	Low Output Limit
PARITY	Parity
PBorGAIN	Proportional Band or Gain Units
PID SETS	Tuning Parameter Sets
PROG END	Program Termination State
PROP BD	Proportional Band
PROP BD2	Proportional Band 2
PV LIMIT	Derived PV Out of Range
RAM TEST	RAM test failed
RAMPUNIT	Engineering units for ramp segments
RATE MIN	Rate in Minutes
RATE2MIN	Rate 2 in Minutes
RECYCLES	Number of Program Recycles
RSET MIN	Reset in minutes/repeat
RSET RPM	Reset in repeats/minute
RSET RPM	Reset in repeats/minute
RSET2MIN	Reset 2 in minutes/repeat
RSET2RPM	Reset 2 in repeats/minute
RSP SRC	Remote Setpoint Source
RV LIMIT	Remote Variable Out of Range
SECURITY	Security Code
SEG1RAMP	Segment #1 Ramp Time
SEG1RATE	Segment #1 Rate Time
SHED SP	Shed Setpoint Recall
SHEDMODE	Shed Controller Mode and Output Level
SHEDTIME	Shed Time
SOAK DEV	Guaranteed Soak Positive or Negative Deviation Value
SP CHANG	Setpoint Change Value
SP HILIM	Setpoint High Limit
SP LOLIM	Setpoint Low Limit
SP PROG	Setpoint Ramp/Soak Programming
SP RAMP	Single Setpoint Ramp
SP TRACK	Local Setpoint Tracking
STATE	Program state at program end
STRT SEG	Start Segment Number
SW VALUE	Automatic Switchover Value
TIME MIN	Single Setpoint Ramp Time
UNITS	Communication Units
XMITTER	Transmitter Characterization
XMITTER2	Transmitter Characterization Input 2

References

Publication Title	Publication Number
UDC3000/UDC5000/UDC6000 RS422/485 Communications Option Manual	51-51-25-35
UDC5000 DMCS Communications option Section of the Gateway Manual	82-50-10-24

Section 1 – Overview

1.1 Introduction

Function

The UDC5000 Universal Digital Controller is a microprocessor-based, one or two loop controller that controls a process either manually or automatically.

The controller produces analog outputs based on operator-entered data and one, two, or three isolated loop related analog input signals. Two loops of control allow Internal Cascade Control.

See the block diagrams for:

- One loop of control - Figure 1-2
- Two loops of control - Figure 1-3
- Internal Cascade control - Figure 1-4

CE Conformity (Europe)

This product is in conformity with the protection requirements of the following European Council Directives: **73/23/EEC**, the Low Voltage Directive, and **89/336/EEC**, the EMC Directive. Conformity of this product with any other "CE Mark" Directive(s) shall not be assumed.

Deviation from the installation conditions specified in this manual, and the special conditions for CE conformity in Section 2.1, may invalidate this product's conformity with the Low Voltage and EMC Directives.

ATTENTION

The emission limits of EN 50081-2 are designed to provide reasonable protection against harmful interference when this equipment is operated in an industrial environment. Operation of this equipment in a residential area may cause harmful interference. This equipment generates, uses, and can radiate radio frequency energy and may cause interference to radio and television reception when the equipment is used closer than 30 meters (98 feet) to the antenna(e). In special cases, when highly susceptible apparatus is used in close proximity, the user may have to employ additional mitigating measures to further reduce the electromagnetic emissions of this equipment.

Continued on next page

Inputs

Two isolated, low-level inputs let you directly connect low-level sensors such as thermocouples, RTD's, or transducers directly to Input 1 or Input 2.

Input 1 to the controller is usually the process variable of the loop. An optional second input can be used as:
- PV Loop 2
- an independent variable to be monitored for alarm purposes only
- as a remote setpoint signal
- for computing the Weighted Average of both inputs
- as the dry bulb input for relative humidity
- connected to a zirconium oxide sensor for measuring Carbon Potential
- Other input algorithms available with the second input are Math options which include Input Summing and Subtracting with or without Ratio and Bias, Feedforward, Mass Flow calculations, or HI/LO Input Select with or without Ratio and Bias.

An optional third input provides a high level, isolated, 4 to 20 mA or 1 to 5 Volts dc signal which can be used as a remote setpoint, process variable, alarm parameter, or feedforward signal, and limited math functions.

Outputs

This universal output controller provides the capability of a single current output, single or dual relay output, or position proportional control.

Output Algorithms

Depending on how many loops you configure, the UDC5000 is available with various preselected output algorithms including:
- Time Proportional Simplex
- Time Proportional Duplex*,
- Current Proportional,
- Current Proportional Duplex
- Current/Relay Duplex (Relay = Heat or Cool),
- Position Proportional Control*

** Time Proportional Duplex, Position Proportional, and 3 Position Step Control are not available on second loop of control.*

Control Algorithms

The basic characteristics of an automatic controller is its control algorithm - the way it restores the controlled variable to the desired value (setpoint). Depending on the Control output type specified, the controller can be configured for the following control algorithms:
- On/Off control**,
- PID-A Equation
- PID-B Equation
- PD with Manual Reset.
- Three Position Step Control**

Duplex control can be configured for all algorithms except 3 Position Step.

*** ON/OFF and 3 Position Step are not available on the second loop of control.*

Continued on next page

Options

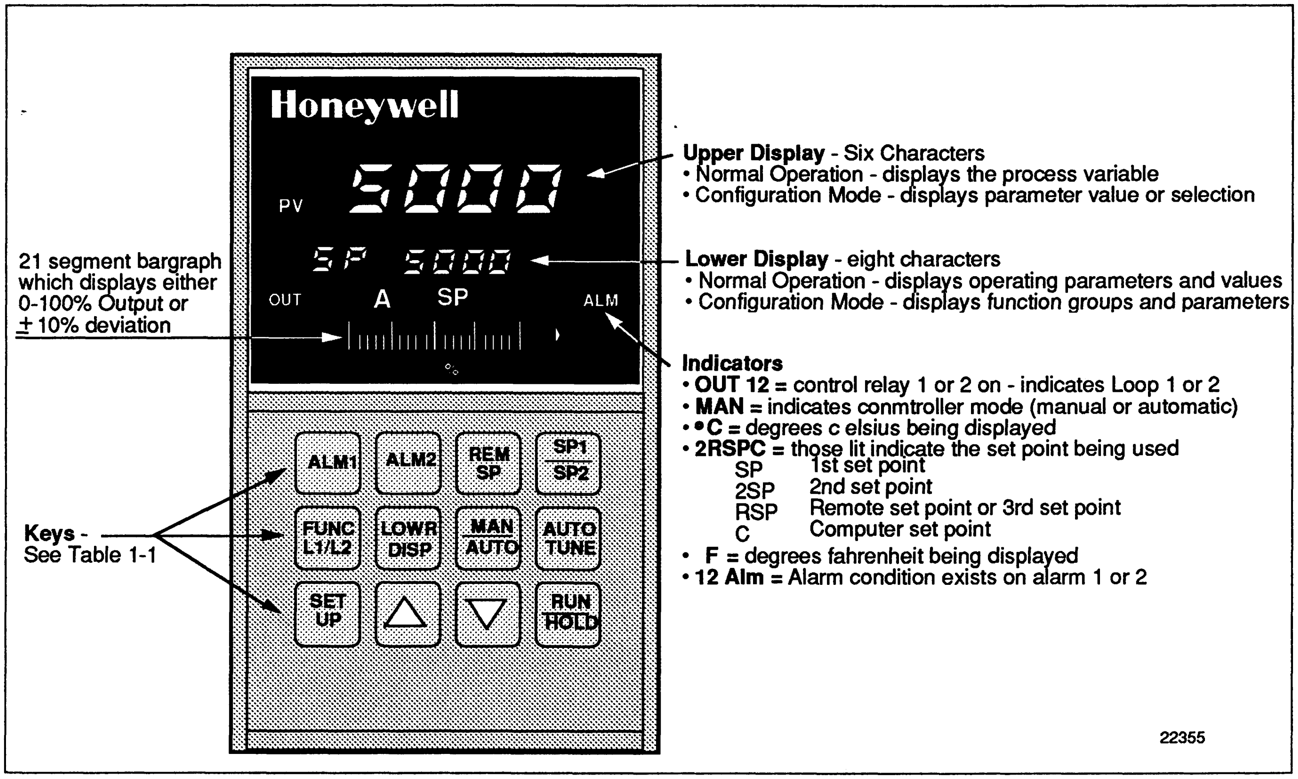
Available options include:

Adaptive Tuning	Continually adjusts the PID tuning parameters in response to Process Variable disturbances and/or Setpoint changes.
Autotune	Automatically calculates and enters into memory, the optimum tuning parameters required for your process. A "Short Tune" procedure lets you obtain approximate tuning constants.
Setpoint Ramp/Soak Programming	Lets you program and store 10 ramp and 10 soak segments to be used as one program or multiple small programs.
Auxiliary Output	Provides a 4 to 20 mA output representing any of six controller parameters for recording or control purposes.
Two Loop Controller	Provides software for two independent loops of control with separate prompts and shared display.
Internal Cascade Control	Uses Loop 2 as the primary loop, with the output of Loop 2 being the Remote Setpoint of Loop 1 (the secondary loop). All output form exist on Loop 1.
2nd Input	Provides a 2nd universal input that can be used as remote setpoint or process variable; or combined with input 1 using the Math Options/Input 2 Algorithms.
Math Options	This option provides various input 2 algorithms. These include Summer/Subtractor, Weighted Average, Multiplier/Divider, Relative Humidity, Carbon Potential, Input High/Low Select, and Feedforward.
Third Input	A high level input which also includes Input 3 algorithm for: - High/Low Select with Input 1 - Summer with Input 1 - Feedforward to either Loop.
Transmitter Power	24Vdc power to supply one or two, 4 to 20mA, 2-wire inputs.
Digital Input	Using either of two remote switch, you can switch on contact closure to any nine configurable modes or parameters.
Communications	Serial communications link integrates with CRT-based RS422/485 or Honeywell's DMCS Distributed systems.
Solid State Relays	One or two SPST solid state contacts rated at 2 amps or 10 amps at 120/240 Volts.
Open Collector Output	Provides one or two open collector outputs rated at 24Vdc/30mA.

1.2 Operator Interface

Displays and Indicators Figure 1-1 shows the operator interface and defines the displays and indicators. The function of the keys is shown in Table 1-1.

Figure 1-1 Operator Interface Displays and Indicators



21 segment bargraph which displays either 0-100% Output or ± 10% deviation

Keys - See Table 1-1

Upper Display - Six Characters
- Normal Operation - displays the process variable
- Configuration Mode - displays parameter value or selection

Lower Display - eight characters
- Normal Operation - displays operating parameters and values
- Configuration Mode - displays function groups and parameters

Indicators
- **OUT 12** = control relay 1 or 2 on - indicates Loop 1 or 2
- **MAN** = indicates conmtroller mode (manual or automatic)
- **•C** = degrees c elsius being displayed
- **2RSPC** = those lit indicate the set point being used
  - SP 1st set point
  - 2SP 2nd set point
  - RSP Remote set point or 3rd set point
  - C Computer set point
- F = degrees fahrenheit being displayed
- **12 Alm** = Alarm condition exists on alarm 1 or 2

Continued on next page

1.2 Operator Interface, Continued

Function of keys

Table 1-1 shows each key on the operator interface and defines its function.

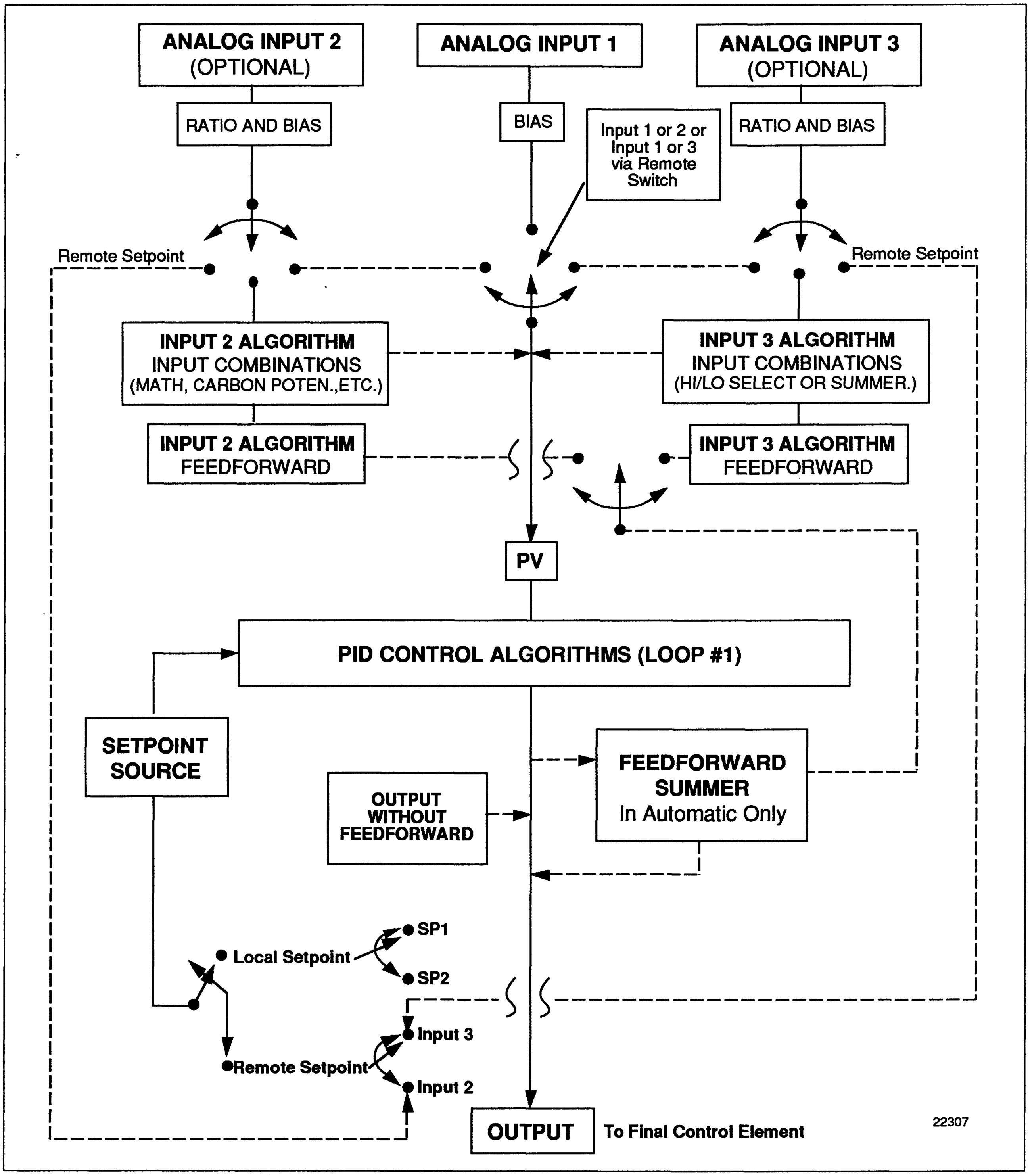
Table 1-1 Function of Keys

Key	Function
ALM 1	• Displays Alarm 1 parameter group.
ALM 2	• Displays Alarm 2 parameter group.
REM SP	• Toggles between local setpoint and remote setpoint or local setpoint 3.
SP1 SP2	• Toggles between Local Setpoint #1 and #2.
FUNC L1/L2	• Used in conjunction with the SET UP key to select the individual functions of a selected Configuration Set Up group. • Used during field calibration procedure. • Also toggles between Loop 1 and Loop 2 display.
LOWR DISP	• Selects any one of the operating parameter to be shown in the lower display. • Used to exit Set Up.
MAN AUTO	• Alternately selects: AUTO Lower display automatically displays setpoint value in engineering units. MAN Lower display automatically indicates output in %.
AUTO TUNE	• Starts the Autotune or Adaptive Tune procedure.
SET UP	• Place the controller in the configuration group select mode. Sequentially displays configuration groups and allows the FUNC key to display individual functions for each group.
▲	• Increases the setpoint, output, or configuration values displayed.
▼	• Decreases the setpoint, output, or configuration values displayed.
RUN HOLD	• Initiated RUN or HOLD of the Setpoint Program option or restores original functions selected in Set Up mode.

1.3 Functional Overviews

Single Loop Controller Figure 1-2 is a Block Diagram of a Single Loop Controller - Loop #1.

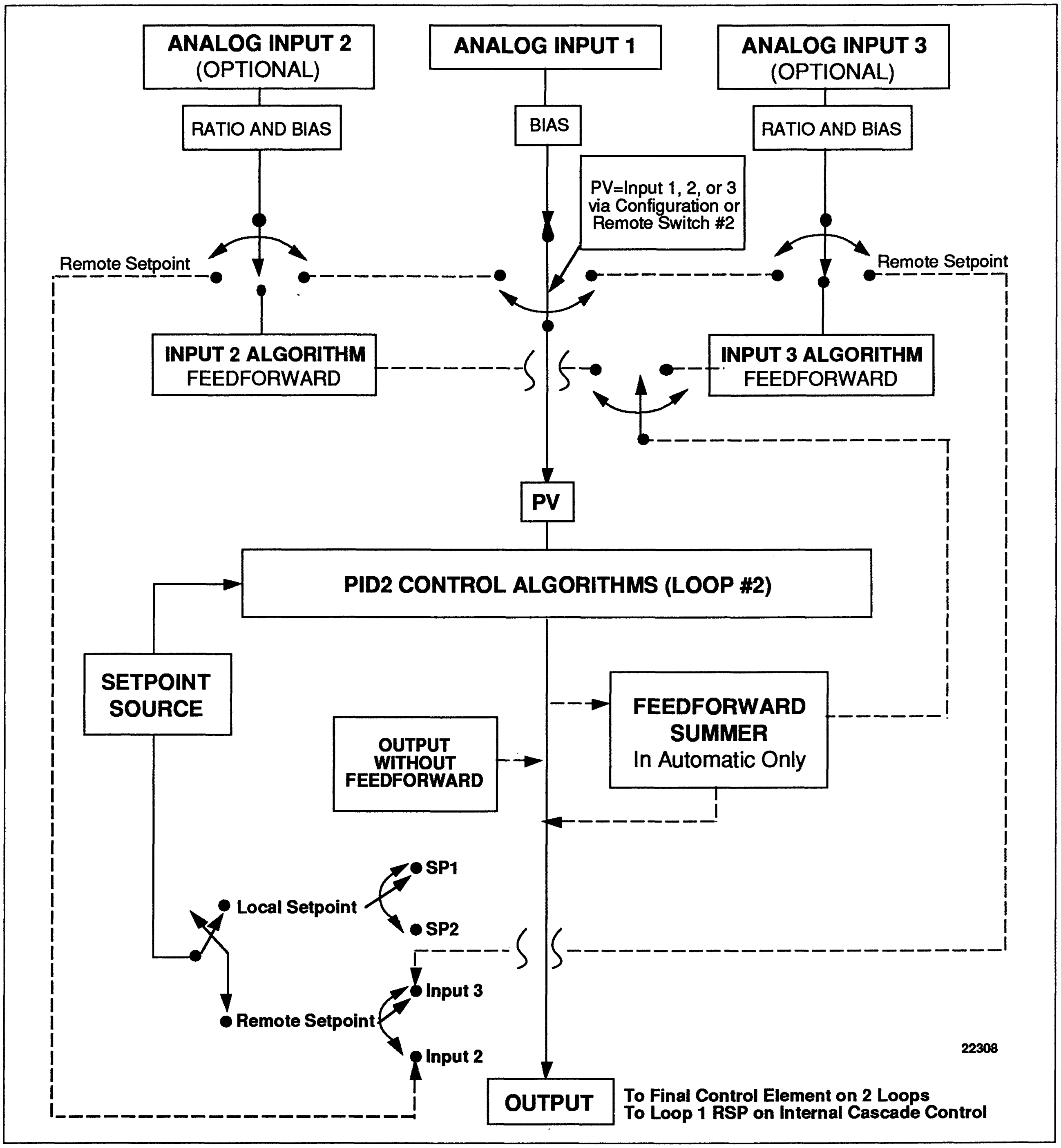
Figure 1-2 Functional Overview of a Single Loop Controller - Loop #1


ANALOG INPUT 2 (OPTIONAL)
ANALOG INPUT 1
ANALOG INPUT 3 (OPTIONAL)
RATIO AND BIAS
BIAS
Input 1 or 2 or Input 1 or 3 via Remote Switch
RATIO AND BIAS
Remote Setpoint
Remote Setpoint
INPUT 2 ALGORITHM INPUT COMBINATIONS (MATH, CARBON POTEN.,ETC.)
INPUT 3 ALGORITHM INPUT COMBINATIONS (HI/LO SELECT OR SUMMER.)
INPUT 2 ALGORITHM FEEDFORWARD
INPUT 3 ALGORITHM FEEDFORWARD
PV
PID CONTROL ALGORITHMS (LOOP #1)
SETPOINT SOURCE
FEEDFORWARD SUMMER In Automatic Only
OUTPUT WITHOUT FEEDFORWARD
Local Setpoint
SP1
SP2
Remote Setpoint
Input 3
Input 2
OUTPUT
To Final Control Element
22307

Continued on next page

Loop 2 Figure 1-3 is a Block Diagram of Loop 2 of a 2 Loop controller.

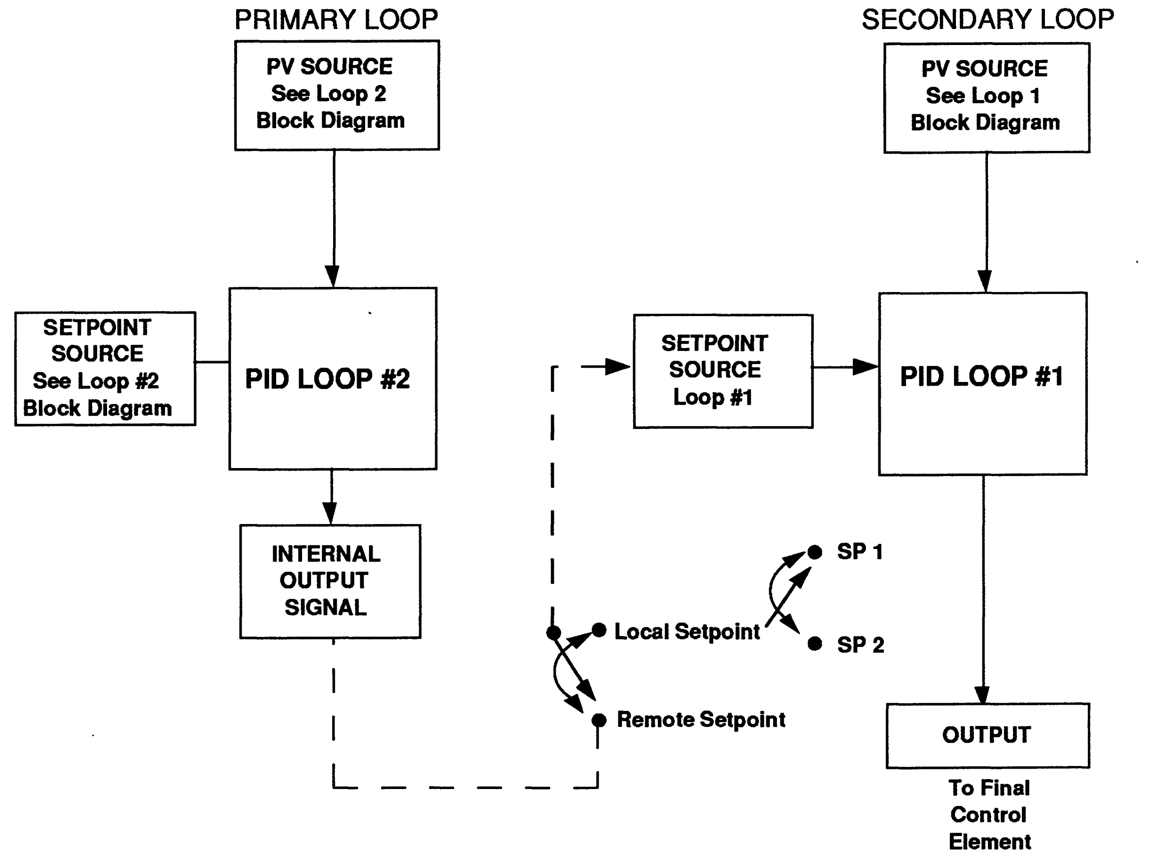
Figure 1-3 Functional Overview of Loop 2 of a 2 Loop Controller


ANALOG INPUT 2 (OPTIONAL)
ANALOG INPUT 1
ANALOG INPUT 3 (OPTIONAL)
RATIO AND BIAS
BIAS
RATIO AND BIAS
PV=Input 1, 2, or 3 via Configuration or Remote Switch #2
Remote Setpoint
Remote Setpoint
INPUT 2 ALGORITHM FEEDFORWARD
INPUT 3 ALGORITHM FEEDFORWARD
PV
PID2 CONTROL ALGORITHMS (LOOP #2)
SETPOINT SOURCE
FEEDFORWARD SUMMER In Automatic Only
OUTPUT WITHOUT FEEDFORWARD
SP1
Local Setpoint
SP2
Input 3
Remote Setpoint
Input 2
22308
OUTPUT
To Final Control Element on 2 Loops
To Loop 1 RSP on Internal Cascade Control

Continued on next page

Internal Cascade Figure 1-4 is a Block Diagram of Internal Cascade for a 2 Loop controller.

Figure 1-4 Functional Overview of Internal Cascade of a 2 Loop Controller



INTERNAL CASCADE RULES

- Loop #2 must be the primary loop.
- Loop #1 must be the secondary (internal or slave) loop because all output forms exist on Loop 1.
- Loop #1 Remote Setpoint is fixed as loop #2 output.

22309

Section 2 – Installation

2.1 Overview

Introduction

Installation of the UDC 5000 Controller consists of mounting and wiring the controller according to the instructions given in this section. The Universal Digital Controller is industrial control that must be panel mounted. The wiring terminals must be enclosed within the panel.
Read the pre-installation information, check the model number interpretation and become familiar with your model selections, then proceed with installation.

What's in this section?

This section contains the following information:

Topic		See Page
2.1	Overview	9
2.2	Model Number Interpretation	11
2.3	Preliminary Installation Checks	12
2.4	Alarm and Control Relay Caution Note	23
2.5	Mounting	24
2.6	Wiring	26
2.7	Wiring Diagrams	28

Continued on next page

Pre-installation information

If the controller has not been removed from its shipping carton, inspect the carton for damage and remove the controller. Inspect the unit for any obvious shipping damage and report any damage due to transit to the carrier.

Make sure a bag containing mounting hardware is included in the carton with the controller.

Check that the model number shown on the inside of the case agrees with what you have ordered. Refer to Figure 2-1.

CE Conformity special conditions (Europe)

Shielded twisted pair cables are required for all Analog I/O, Process variable, RTD, Thermocouple, dc millivolt, low level signal, 4-20 mA, Digital I/O, and computer interface circuits. For performance Criterion B under special conditions, the user must install ferrite suppression filters (see Section 2.7 for typical installation) on all wires connected to the controller. Refer to Appendix B - Severe Electrical Noise Environments for additional installation guidance.

Operating limits

We recommend that you review and adhere to the operating limits listed in Table 2-1 when you install your controller.

Table 2-1 Operating Limits

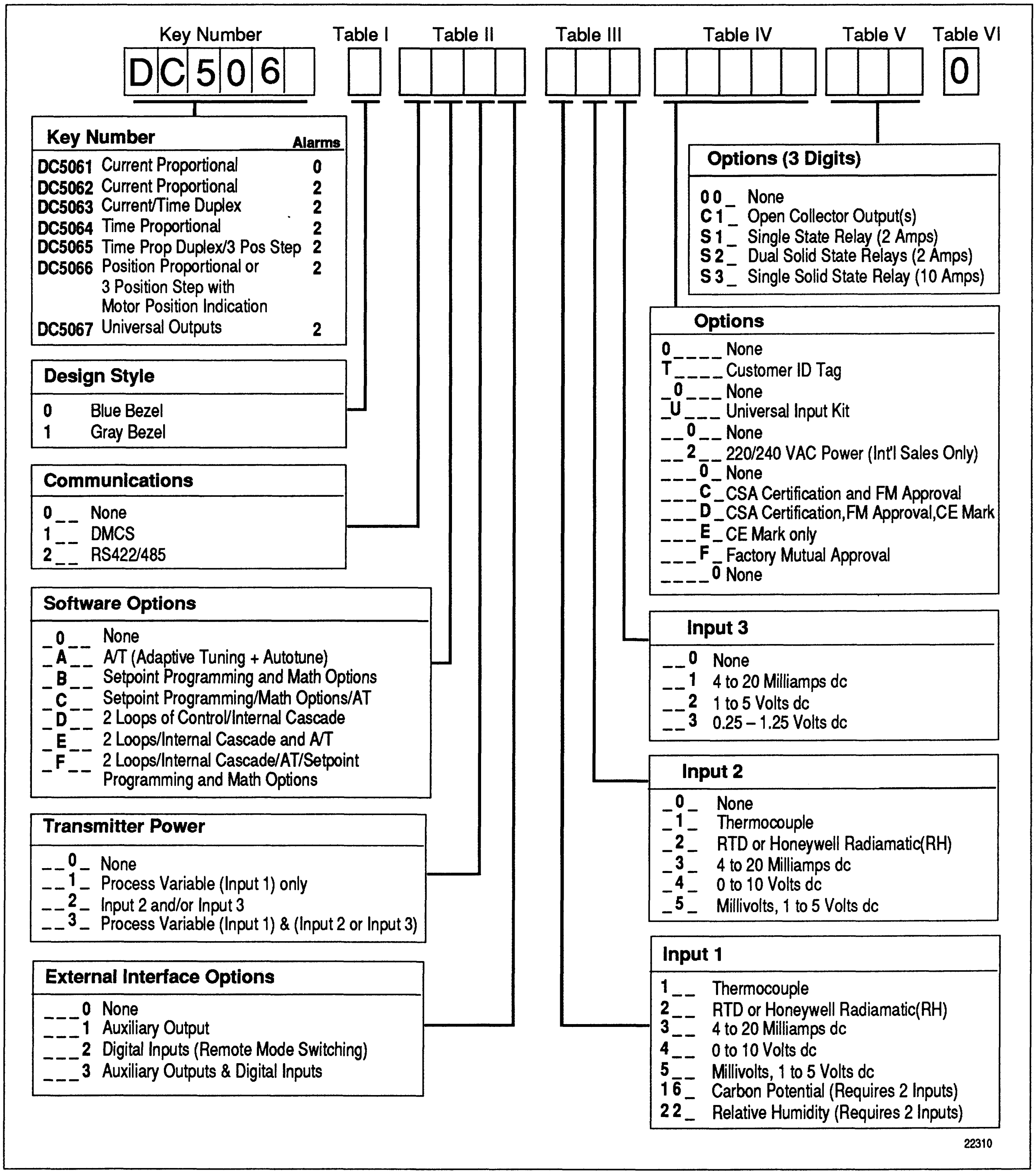
Condition	Specifications
Ambient Temperature	32 to 140°F (0 to 60°C)
Relative Humidity	5 to 90% RH at 40°C (104°F)
Vibration Frequency Acceleration	 0 to 200Hz 0.2g
Mechanical Shock Acceleration Duration	 5g 30ms
Power Voltage Frequency(Hz)	 85 to 132 Vac 170 to 264 Vac 48 to 52 58 to 62
Transmitter Supply Voltage (at input terminals)	22 to 26 Vac @ 50mA
Power Consumption	13VA Maximum

2.2 Model Number Interpretation

Model number

The model number interpretation is shown in Figure 2-1. Write the model number into the spaces provided and compare it to the model number interpretation. This information will also be useful when you wire your controller.

Figure 2-1 Model Number Interpretation



Key Number		Alarms
DC5061	Current Proportional	0
DC5062	Current Proportional	2
DC5063	Current/Time Duplex	2
DC5064	Time Proportional	2
DC5065	Time Prop Duplex/3 Pos Step	2
DC5066	Position Proportional or 3 Position Step with Motor Position Indication	2
DC5067	Universal Outputs	2

Design Style	
0	Blue Bezel
1	Gray Bezel

Communications	
0__	None
1__	DMCS
2__	RS422/485

Software Options	
_0__	None
_A__	A/T (Adaptive Tuning + Autotune)
_B__	Setpoint Programming and Math Options
_C__	Setpoint Programming/Math Options/AT
_D__	2 Loops of Control/Internal Cascade
_E__	2 Loops/Internal Cascade and A/T
_F__	2 Loops/Internal Cascade/AT/Setpoint Programming and Math Options

Transmitter Power	
__0_	None
__1_	Process Variable (Input 1) only
__2_	Input 2 and/or Input 3
__3_	Process Variable (Input 1) & (Input 2 or Input 3)

External Interface Options	
___0	None
___1	Auxiliary Output
___2	Digital Inputs (Remote Mode Switching)
___3	Auxiliary Outputs & Digital Inputs

Options (3 Digits)	
00_	None
C1_	Open Collector Output(s)
S1_	Single State Relay (2 Amps)
S2_	Dual Solid State Relays (2 Amps)
S3_	Single Solid State Relay (10 Amps)

Options	
0____	None
T____	Customer ID Tag
_0___	None
_U___	Universal Input Kit
__0__	None
__2__	220/240 VAC Power (Int'l Sales Only)
___0_	None
___C_	CSA Certification and FM Approval
___D_	CSA Certification,FM Approval,CE Mark
___E_	CE Mark only
___F_	Factory Mutual Approval
____0	None

Input 3	
__0	None
__1	4 to 20 Milliamps dc
__2	1 to 5 Volts dc
__3	0.25 – 1.25 Volts dc

Input 2	
_0_	None
_1_	Thermocouple
_2_	RTD or Honeywell Radiamatic(RH)
_3_	4 to 20 Milliamps dc
_4_	0 to 10 Volts dc
_5_	Millivolts, 1 to 5 Volts dc

Input 1	
1__	Thermocouple
2__	RTD or Honeywell Radiamatic(RH)
3__	4 to 20 Milliamps dc
4__	0 to 10 Volts dc
5__	Millivolts, 1 to 5 Volts dc
16_	Carbon Potential (Requires 2 Inputs)
22_	Relative Humidity (Requires 2 Inputs)

2.3 Preliminary Installation Checks

Introduction

Before you install the controller, remove the chassis by pulling the front door down, loosening the screw on the front and pulling the chassis out.

Make the preliminary checks listed in Table 2-2 based on the model number of your controller.

Table 2-2 Preliminary Checks

Check	If you have Model	See Page
Operating Voltage Selection	All Models	13
Input Group Type Selection	All Models	14
Optional Input Three, Jumper Selection	DC506X-0-XXXX-XX1 DC506X-0-XXXX-XX2	17
Control Relay Contact Selection	DC5063 DC5064 DC5065 DC5066 DC5067	18
Alarm Relay Contact Selection	DC506X-0-XX1X-XX DC506X-0-XX2X-XX DC506X-0-XX3X-XX	20

Electrical considerations

The controller is considered "rack and panel mounted equipment" per EN 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements. Conformity with 72/23/EEC, the Low Voltage Directive requires the user to provide adequate protection against a shock hazard. The user shall install this controller in an enclosure that limits OPERATOR access to the rear terminals.

Controller grounding

PROTECTIVE BONDING (grounding) of this controller and the enclosure in which it is installed shall be in accordance with National and local electrical codes. To minimize electrical noise and transients that may adversely affect the system, supplementary bonding of the controller enclosure to a local ground, using a No. 12 (4 mm^2) copper conductor, is recommended.

Continued on next page

Operating voltage selection

The controller is shipped, configured for use with 120 Volts as shown in Figure 2-2.

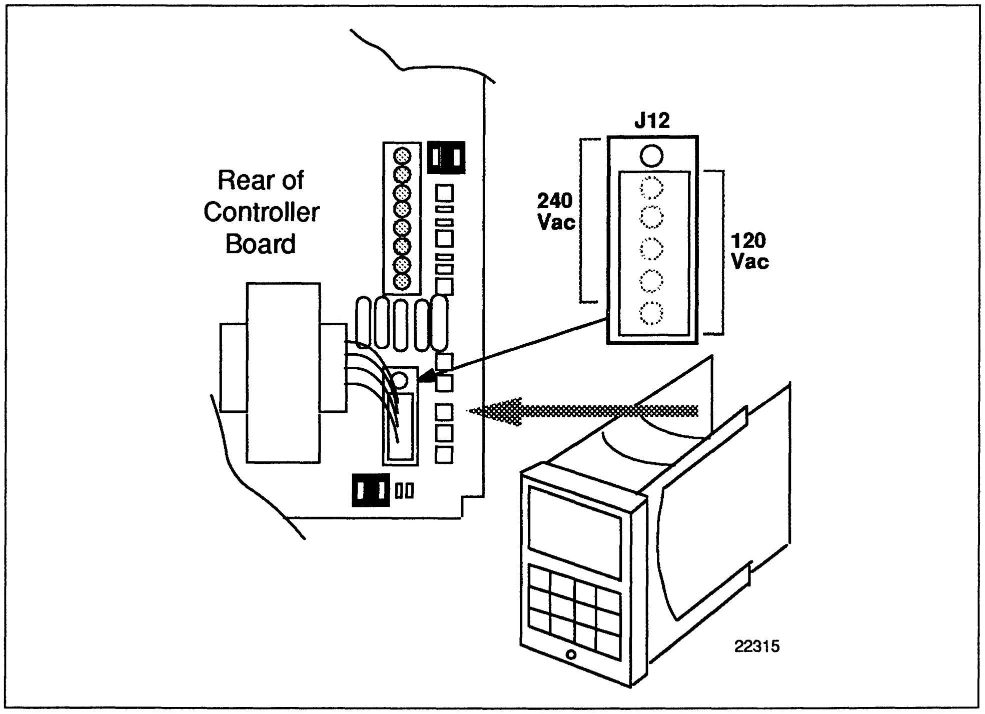
CAUTION **OPERATING A 120 VOLT CONTROLLER AT 240 VOLTS WILL DAMAGE THE UNIT.**

•Make sure that the transformer connection (J12) at the back of the controller is positioned correctly for the operating voltage (120 or 240) that will be used.

•If you want to use 240 Volts, move the connector to the position shown for 240 Volts in Figure 2-2.

•If you want to change the operating frequency from 60Hz to 50Hz, see *Section 3 - Configuration.*

Figure 2-2 Operating Voltage Selection



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Configure the input group type)

The UDC5000 controller will be shipped with Input 1 and 2 set up for the range of 0 to 10 mV Linear range (see Figure 2-1 for model identification).

Your controller is shipped with only the parts needed for your application as selected in the model number. You can change your controller to a different input group if desired.

When you change from some input groups to others, (for example: 4-20 mA to Thermocouple), you must adapt the input circuitry so that it will be compatible with the input signal.

For the following type of actuation sources:
- Thermocouples and RTD
- 0 to 10 Volts
- 4 to 20 Milliamps

you must:
- Install or remove a jumper on the controller printed wiring board depending on the actuation type/range to which you are changing (See "*Dual Jumper for Input 1 and Input 2*").
- Install and/or remove a resistor assembly depending on the actuation type or range to which you are changing (see "*Resistor Assembly*").

Continued on next page

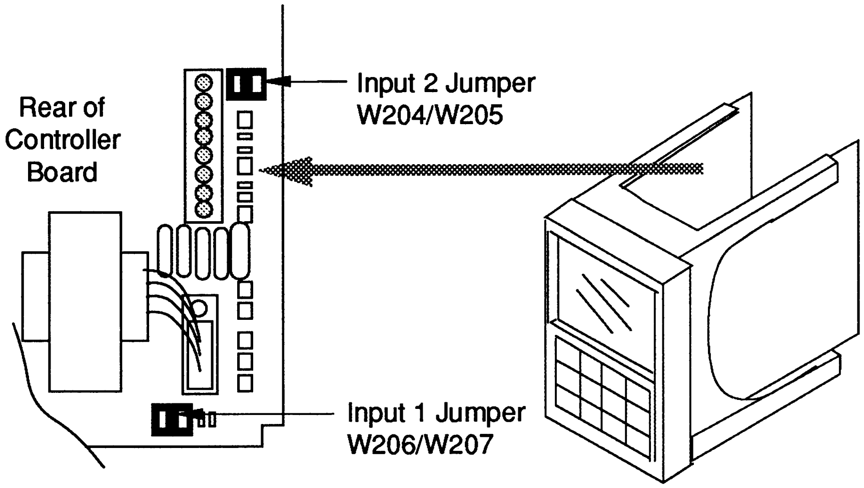
Dual jumper for input 1 and input 2

Depending on the type of input actuation or range that you are selecting, install or remove the dual jumper at the desired position on the controller board. Refer to Figure 2-3 and follow the procedure in Table 2-3.

Table 2-3 Installing or Removing Dual Jumper for Input 1 and 2

Step	Action
1	Locate the two dual jumper positions identified as W204/W205 and W206/W207 on the rear of the controller board (see Figure 2-3) ATTENTION The white lines on the top of the jumper must be vertical for proper continuity.
2	Determine which of the two dual jumper positions on the controller board is applicable to the input circuit that you want to change: INPUT NO. 1: Position W206/W207 INPUT NO. 2: Position W204/W205 Refer to Figure 2-3 for jumper selection.
3	Install or remove the jumper(s).

Figure 2-3 Dual Jumper Location



Type of Actuation	Input 1 W206/W207	Input 2 W204/W205
T/C, RTD	Jumper	Jumper
4 to 20 mA (no transmitter power)	None**	None**
All others (transmitter power)	None	None

For example: If you are changing input 2 to a 0 to 10 Volt range, remove the jumper if it appears in the above position, if you are changing to thermocouple or RTD actuation, install the jumper.

** NOTE: If you are changing from 4 to 20 mA with transmitter power, you must disable the transmitter power board. Refer to page 22.

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Continued on next page

2.3 Preliminary Installation Checks, Continued

Resistor assembly

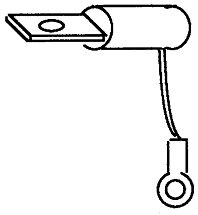
You can order a Universal Input Kit (Part Number 30754471-501) from which you can choose the appropriate resistor to install at the appropriate input terminals. Figure 2-4 gives you a graphic view of these resistors and their part number as well as the inputs for which they are used.

Select the appropriate resistor from Figure 2-4 and install it at the appropriate input terminals as shown on the external wiring diagram in Figure 2-13.

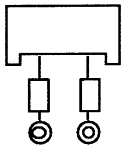
ATTENTION When installing a cold junction for a T/C input, remove the "R" screw (terminal 21 or 18 as applicable) from the terminal board, and install the resistor assembly into its place.

Figure 2-4 Resistor Assembly Selection

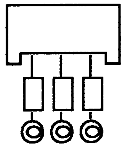
Thermocouple Input Actuations
Cold Junction Resistor
Part Number 30757088-501



4 to 20 mA Range
62.5 ohm Precision Resistor
Part Number 30754466-501



0 to 10 Volt Range
Voltage Divider Resistor
Part Number 30754465-001



RTD, 0 to 10 mV, 10 to 50 mV, RAD, or 1 to 5 Volts Ranges
No resistor required. Remove if changing from T/C, 0 to 10 Vdc, or 4 to 20 mA.

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Continued on next page

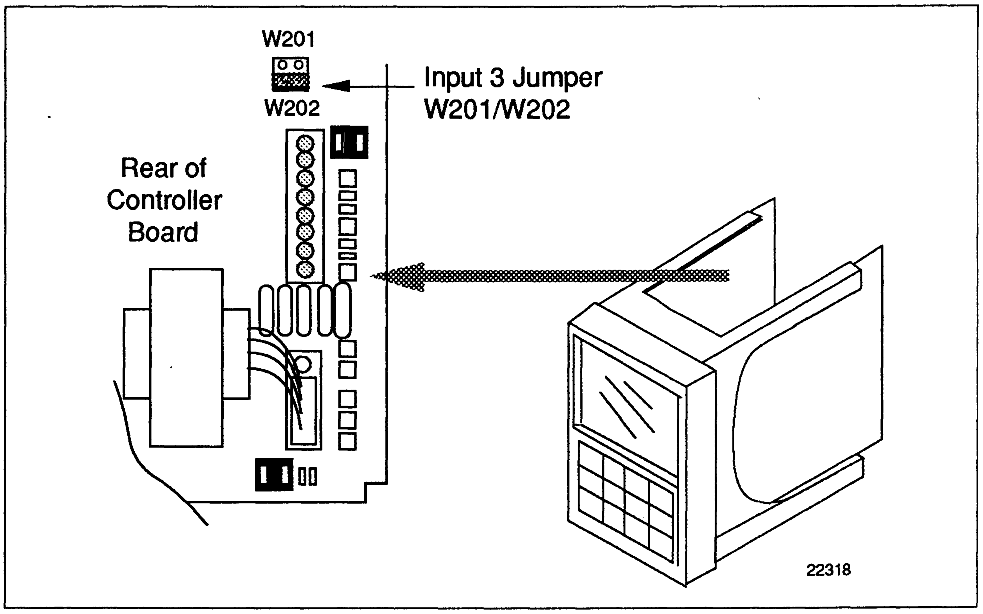
Checking the Input 3 jumper selection

For controllers with the third input option, jumper W201/W202 is the third input selector. Refer to Figure 2-5 for jumper location and place the jumper as follows:

- No Third Input or Position Proportional Output = Jumper Position W201
- Third Input selected = Jumper Position W202

ATTENTION Third Input and Positional Proportional Output are mutually exclusive.

Figure 2-5 Input 3 Jumper Location



Calibrating the position proportional output

Note that the Position Proportional Output or Three Position Step Models (DC5066) must have the output calibrated per Subsection 8.3 - "Position Proportional Output Calibration" to ensure the displayed output (slidewire position) agrees with the actual final control element position.
Model DC5065, Three Position Step Models only, requires that only the motor time be entered (See subsection 8.3, **Full calibration is not required**).

Continued on next page

2.3 Preliminary Installation Checks, Continued

Checking the control relay contact selection

The controller has been shipped with CONTROL relays configured for **Normally Open** contacts as shown in Figure 2-6 If you want to change the relay action, refer to Figure 2-6 for jumper location and Table 2-4 for Relay Contact information and reposition the jumpers on the controller board for (NC) Normally Closed contacts on the control relay as listed below:

JUMPER POSITION	CONTROL RELAY	RELAY ACTION
W110	#1	N.C.
W111	#1	N.O.
W112	#2	N.C.
W113	#2	N.O.

ATTENTION Control relays operate in the standard control mode i.e. Energized when output state is ON.

Table 2-4 Control Relay Contact Information

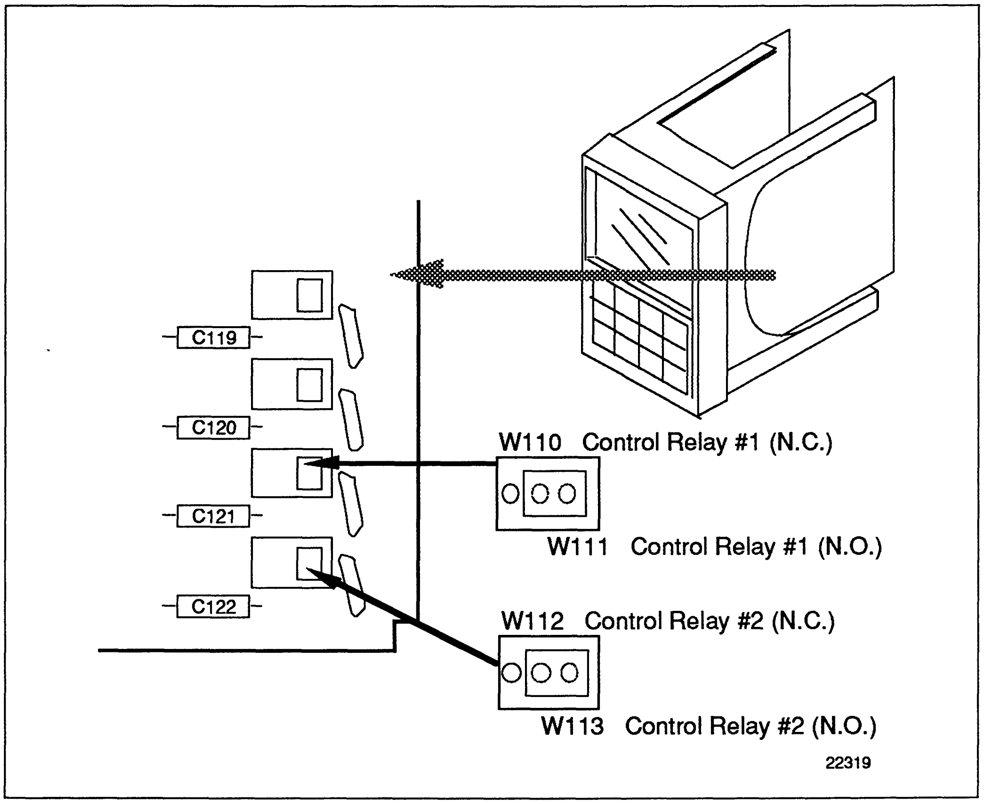
UNIT POWER	CONTROL RELAY JUMPER	CONTROL RELAY CONTACT	#1 OR #2 OUTPUT INDICATOR STATUS
OFF	N.O.	Open	Off
	N.C.	Closed	
ON	N.O	Open	Off
		Closed	On
	N.C	Closed	Off
		Open	On

CAUTION When alarm or control relay are used to drive AC-powered customer solid state relays, be sure that the external relay are functioning properly. *See subsection 2.4 - Caution Note* or *Section 9 - Troubleshooting* if the external relays are not being activated.

Continued on next page

Checking the control relay contact selection, continued

Figure 2-6 Control Relay Jumper Placement


C119
C120
C121
C122
W110 Control Relay #1 (N.C.)
W111 Control Relay #1 (N.O.)
W112 Control Relay #2 (N.C.)
W113 Control Relay #2 (N.O.)
22319

Continued on next page

Checking the Alarm relay contact selection

The controller has been shipped with ALARM relays configured for **Normally Closed** contacts as shown in Figure 2-7. If you want to change the relay action, refer to Figure 2-7 for jumper location and Table 2-5 for Alarm Relay Contact information and reposition the jumpers on the controller board for (NO) Normally Open contacts on the alarm relay as listed below:

JUMPER POSITION	ALARM RELAY	RELAY ACTION
W106	#2	N.O.
W107	#2	N.C.
W108	#1	N.O.
W109	#1	N.C.

ATTENTION Alarm relays are designed to operate in a failsafe mode i.e. De-energized during alarm state. This results in alarm actuation when power is OFF or when initially applied, until the unit completes self-diagnostics. If power is lost to the unit, the alarms will function.

Table 2-5 Alarm Relay Contact Information

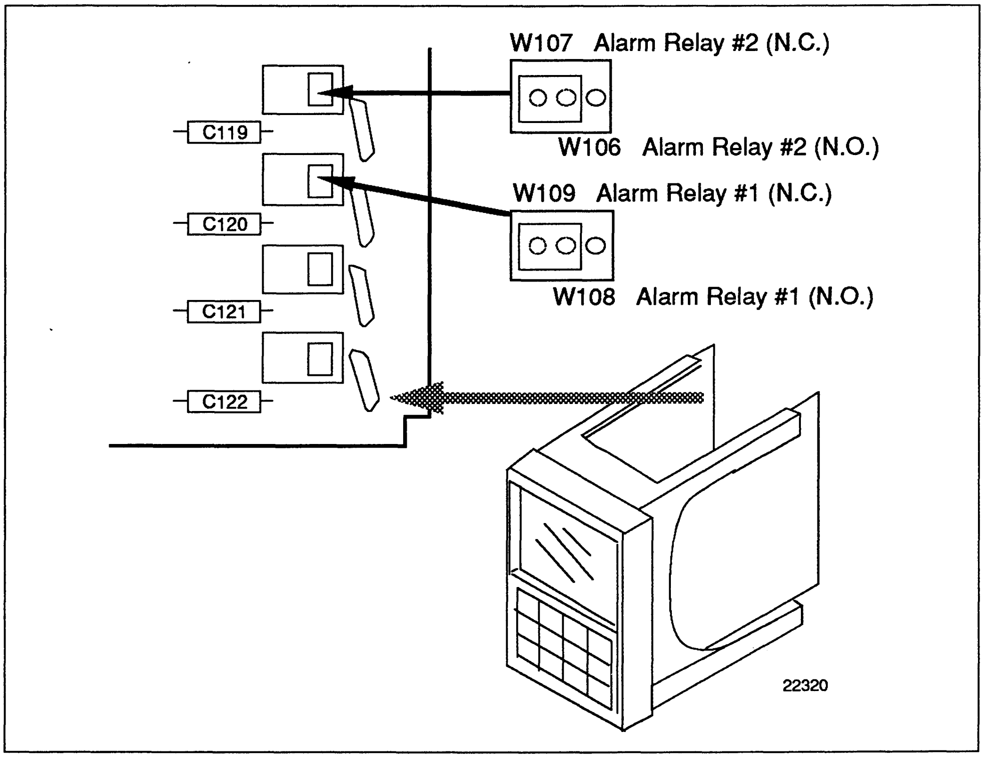
UNIT POWER	ALARM RELAY JUMPER	VARIABLE NOT IN ALARM		VARIABLE IN ALARM STATE	
		RELAY CONTACT	INDICATORS	RELAY CONTACT	INDICATORS
Off	N.O.	Open	Off	Open	Off
	N.C.	Closed		Closed	
On	N.O.	Closed	Off	Open	On
	N.C.	Open		Closed	

CAUTION When alarm or control relay are used to drive AC-powered customer solid state relays, be sure that the external relay are functioning properly. See *Subsection 2.4 - Caution Note* or *Section 9 - Troubleshooting* if the external relays are not being activated.

Continued on next page

Checking the Alarm relay contact selection, continued

Figure 2-7 Alarm Relay Jumper Placement


W107 Alarm Relay #2 (N.C.)
W106 Alarm Relay #2 (N.O.)
W109 Alarm Relay #1 (N.C.)
W108 Alarm Relay #1 (N.O.)
C119
C120
C121
C122
22320

Continued on next page

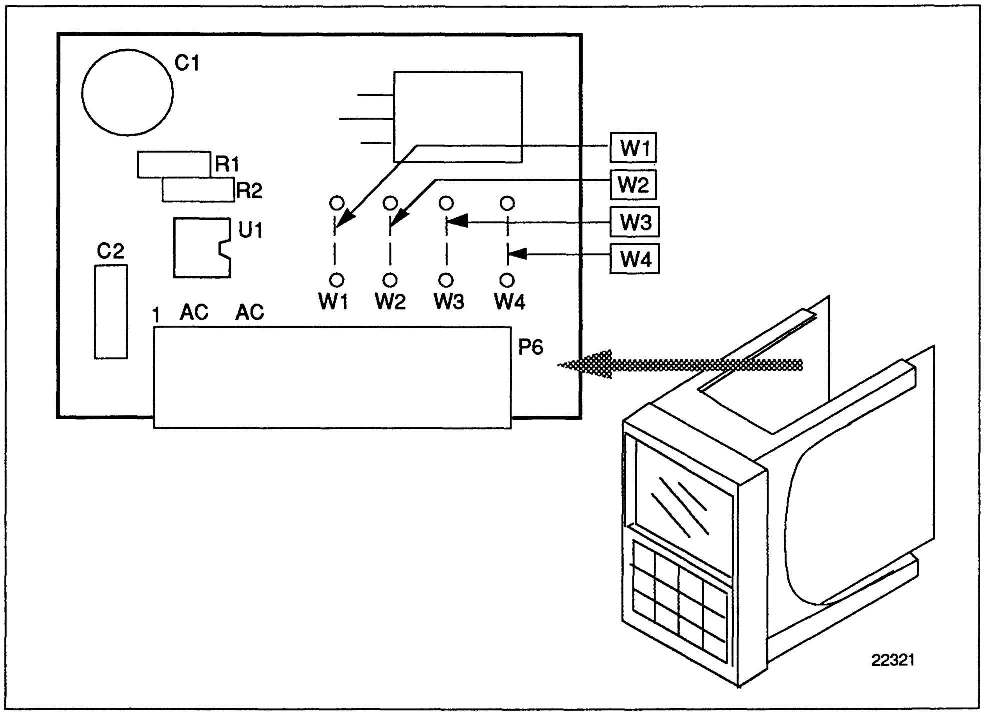
Checking the transmitter power selection

The transmitter power board, which is plugged into the controller board, is configured at the factory in accordance with your model number selection (None, Input 1, Input 2, input 3, or all).

If you want to change the transmitter power configuration, install the cowbell jumpers, supplied with the power board, across the appropriate pins on the power board as indicated below and shown in Figure 2-8.

TRANSMITTER POWER	JUMPER POSITIONS
Input 1 only	W3 and W4
Input 2 or Input 3	W1 and W2
Input 1, 2, or 3	W1, W2, W3, W4
Disable Inputs	Remove all jumpers

Figure 2-8 Transmitter Power Jumper Positions



2.4 Alarm and Control Relay Caution Note

Alarm and Control Relay

CAUTION The alarm and control relay output suppression (snubber) circuitry can be extremely critical when controlling processes and maintaining plant safety. The UDC 5000 Universal Digital Controller is shipped with a board-mounted R-C suppression circuit. Its purpose is to protect the relay contacts from arcing due to high energy spikes. These spikes could occur when driving highly inductive loads and fast cycle-time processes. However, in certain AC-powered, external solid state relays with very high input impedance, an undesirable leakage current can flow in the R-C suppression circuit and cause a voltage across the external load. This prevents deactivation of your external device (such as Solid State relay) even though our display and internal relay are functioning correctly.

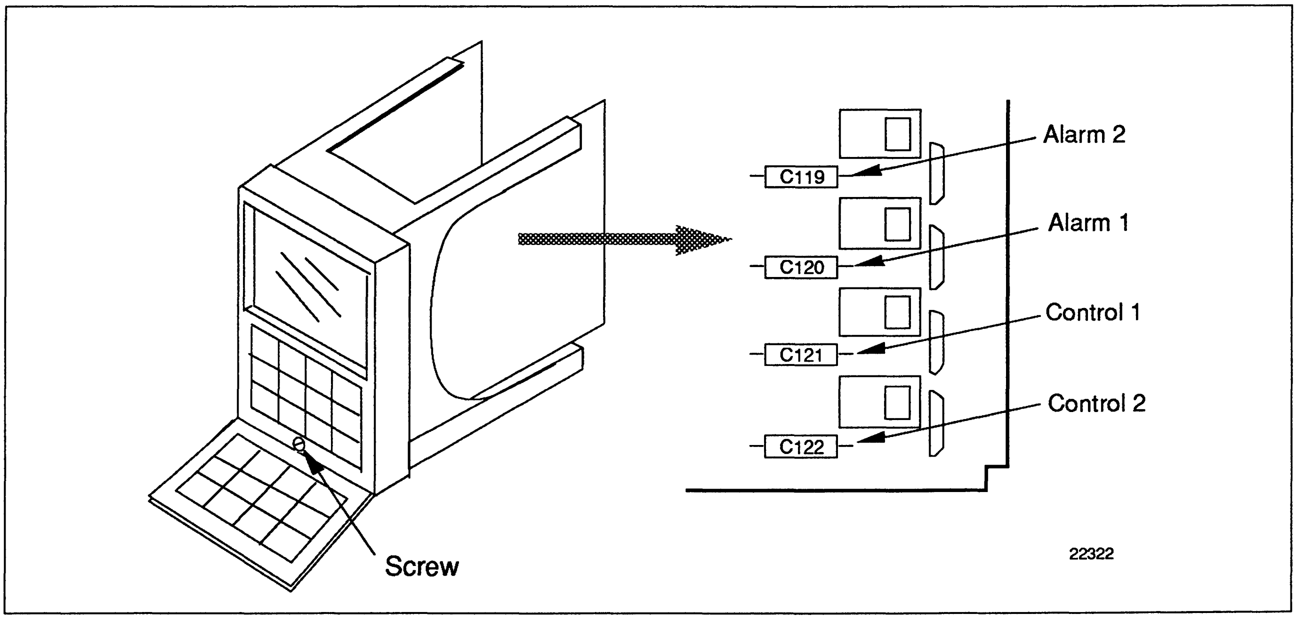
The fix, as shown in Figure 2-9 below, is to open the correct R-C circuit by cutting one of the capacitor leads. This is acceptable because if the above problem occurred, the suppression circuit was not needed. Opening the circuit eliminates any leakage current flow and allows the external relay to function normally.

Refer to Figure 2-9 and follow the procedure in Table 2-6 to make the fix.

Table 2-6 Procedure to Open the R-C Circuit

Step	Action
1	Pull the front door down, loosen the screw on the front, and pull the chassis out of the case.
2	Open the desired circuit by cutting the appropriate capacitor lead (see Figure 2-9).
3	Return the chassis to the case.

Figure 2-9 R-C Circuit Capacitor Location



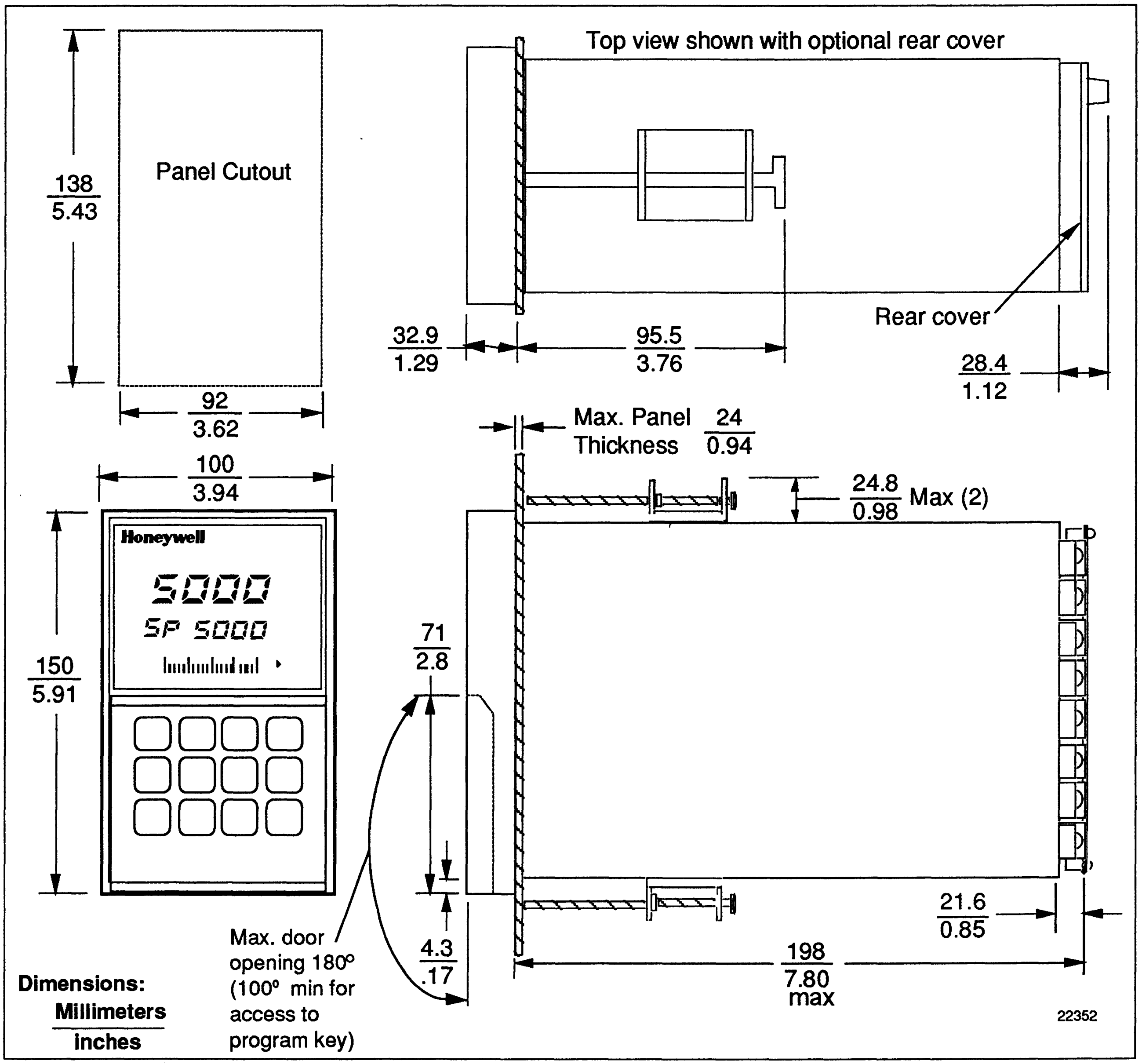
2.5 Mounting

Physical considerations The controller can be mounted on either a vertical or tilted panel using the mounting kit supplied. Adequate access space must be available at the back of the panel for installation and servicing activities.

The overall dimensions and panel cutout requirements for mounting the controller are shown in Figure 2-10.

Overall dimensions Figure 2-10 shows the overall dimensions for mounting the controller.

Figure 2-10 Dimensions



Continued on next page

Note Model Number

Before mounting the controller, refer to the nameplate on the outside of the case and make a note of the model number. It will help later when selecting the proper wiring configuration.

Mounting procedure

Follow the procedure In Table 2-7 below to mount the controller.

Table 2-7 Mounting Procedure

Step	Action
1	Mark and cut out the controller hole in the panel according to the dimension information in Figure 2-10. There is no minimum horizontal spacing defined. Vertical spacing must be provided for access to the mounting kit brackets.
2	Loosen the screw on the front of the controller located under the door. Pull the chassis out of the case.
3	Orient the case properly and slide it through the panel hole from the front.
4	Remove the mounting kit (#30755050-001)from the shipping container, and install the kit as follows: • Install the screws into the threaded holes of the clips. • Insert the prongs of the clips into the two holes in the top and bottom of the case. • Tighten both screws to secure the case against the panel. • Carefully slide the chassis assembly into the case, press to close and tighten the screw. Replace the screw cover.
5	In addition to the mounting kit, a Rear Terminal Cover Kit (#30755494-001) is also provided. Also available is an adapter kit for DIN 43700 Panel Cutout (5.43 in. x 5.43 in.) to fit Dialatrol, Barber-Colemen 560, and Leeds and Northrup E Max cutout, Part Number 30752640-001.

2.6 Wiring

Taking electrical noise precautions

Electrical noise is composed of unabated electrical signals which produce undesirable effects in measurements and control circuits.

Digital equipment is especially sensitive to the effects of electrical noise. Your controller has built-in circuits to reduce the effect of electrical noise from various sources. If there is a need to further reduce these effects:

- Separate External Wiring - separate connecting wires into bundles (see Table 2-8) and route the individual bundles through separate conduits or metal trays.
- Use Suppression Devices - for additional noise protection, you may want to add suppression devices at the external source. Appropriate suppression devices are commercially available.

NOTE For additional noise information, refer to *Appendix B*.

Permissible wire bundling

Table 2-8 shows which wire functions should be bundled together.

Table 2-8 Permissible Wiring Bundling

Bundle No.	Wire Functions
1	• Line power wiring • Earth ground wiring • Control relay output wiring • Line voltage alarm wiring
2	Analog signal wire, such as: • Input signal wire (thermocouple, 4 to 20 mA, etc.) • 4-20mA output signal wiring • Slidewire feedback circuit wiring • Digital input signals • Communications
3	• Low voltage alarm relay output wiring • Low voltage wiring to solid state type control circuits

CE Conformity, ferrite suppression filters

You must install ferrite suppression filters on all wires connected to the controller. ©Fair-Rite Products Corp. part number 0443164151, or equivalent, shall be installed as shown in Figures 2-12 to 2-22, one filter for each circuit group. Cables with an outer jacket diameter larger than 6.7 mm (0.264 in.) may require the outer jacket to be removed to fit the required one complete turn in the filter, or the selection of a different cable.

Control/Alarm circuit wiring

The insulation of wires connected to the Control/Alarm terminals shall be rated for the highest voltage involved. Extra Low Voltage (ELV) wiring (input, current output and low voltage Control/Alarm circuits) shall be separated from HAZARDOUS LIVE (>30Vac, 42.4 V peak or 60 Vdc) wiring per Table 2-8.

Continued on next page

Identify your wiring requirements

To determine the appropriate diagrams for wiring your controller, refer to the model number interpretation in this section. The model number of the controller contains selection codes that identify the Input type, Output type, Standard Input Ranges, Number of Alarms, Software Options, and Optional selections. The model number of the controller can be found on the outside of the case and or chassis.

Wiring the controller

Using the information contained in the model number, select the appropriate wiring diagrams from the figures listed below and wire the controller accordingly.

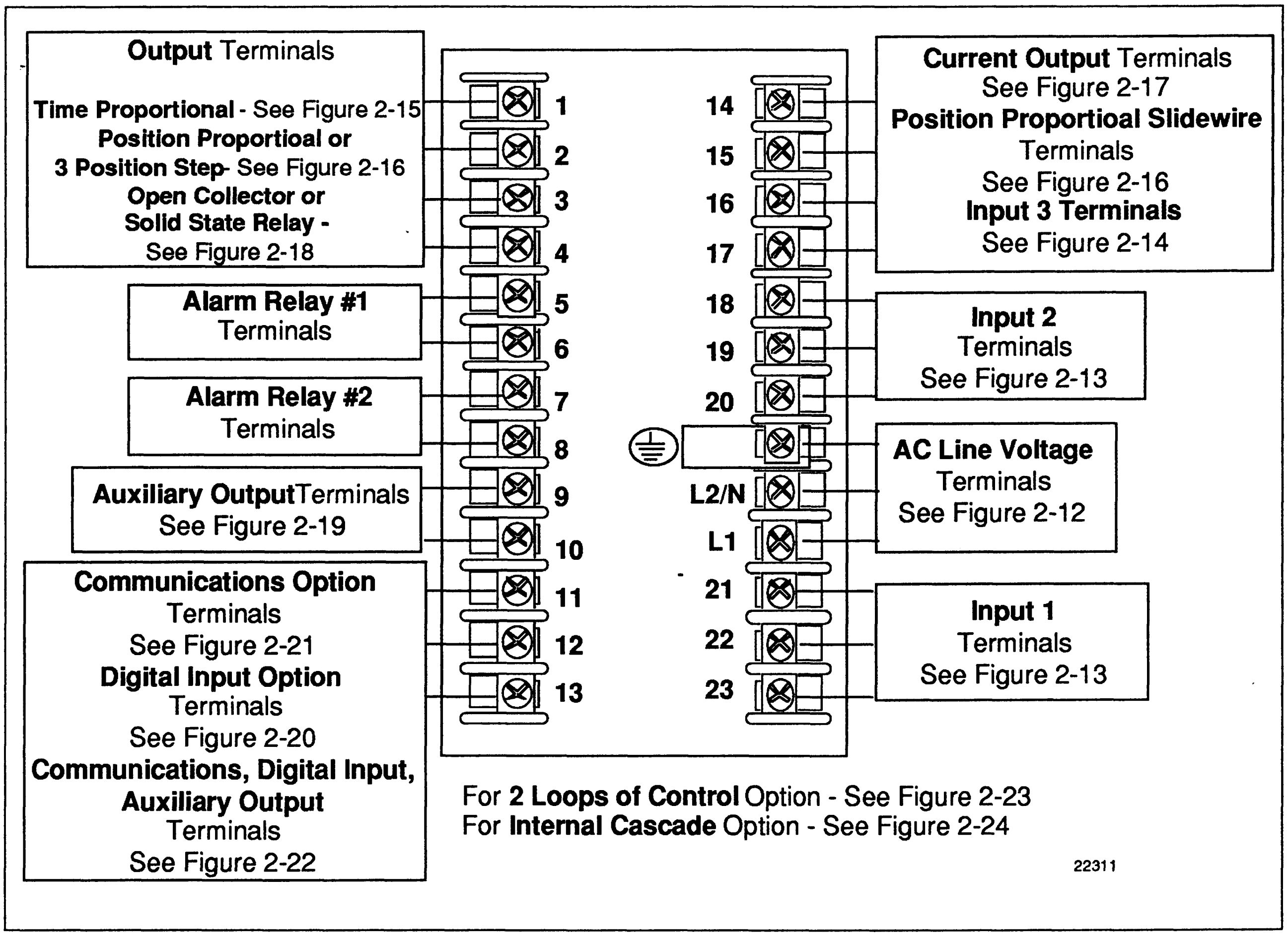
Wiring Requirements	Figure
Composite Wiring Diagram	2-11
AC Line Power	2-12
Inputs #1 and #2	2-13
Input #3	2-14
Time Proportional Output	2-15
Position Proportional Output	2-16
Current Proportional Output	2-17
Open Collector or Solid State Relay Output	2-18
Auxiliary Output	2-19
Digital Input Option	2-20
Communications Option	2-21
Communications and Digital Input with Auxiliary Output	2-22
2 Loops of Control	2-23
Internal Cascade	2-24

2.7 Wiring Diagrams

Composite wiring diagram

Figure 2-11 is a composite wiring diagram of the UDC5000 controller. It identifies the terminal designations and their functions. Refer to the individual diagrams listed to wire the controller according to your requirements.

Figure 2-11 Composite Wiring Diagram



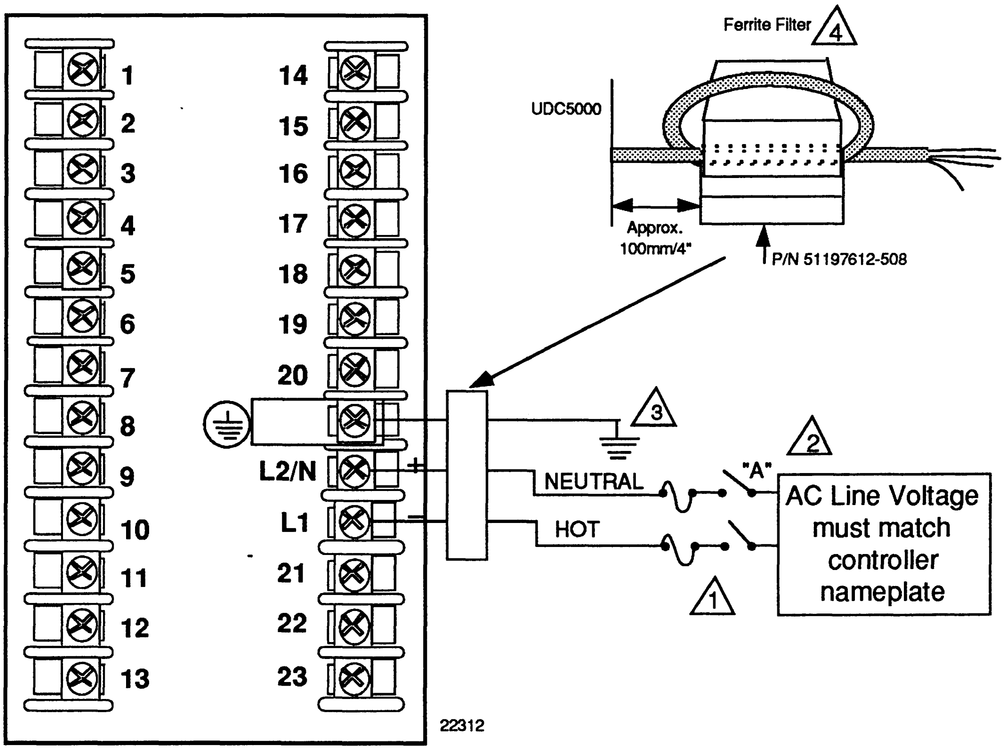
Continued on next page

Line voltage wiring

This equipment is suitable for connection to 120/240 Vac, 50/60 Hz, power supply mains. It is the user's responsibility to provide a switch and non time delay (North America), quick-acting, high breaking capacity, Type F, (Europe) 1/2 A, 250 V fuse(s) or circuit-breaker as part of the installation. The switch or circuit-breaker shall be located in close proximity to the controller, within easy reach of the OPERATOR. The switch or circuit-breaker shall be marked as the disconnecting device for the controller.

Figure 2-12 shows the wiring connections for line voltage.

Figure 2-12 Line Voltage Wiring



△1 The Universal Digital controller and the enclosure in which it is mounted shall be grounded in accordance with National and Local electrical codes. Provide a switch and a non time delay (North American), quick-acting, high breaking capacity, type F, (Europe) 1/2 A, 250V fuse(s), or circuit breaker for 120/240 Vac operation, as part of this installation.

△2 If power service has grounded neutral, connect lead "A" to neutral and omit the fuse in the neutral lead.

△3 PROTECTIVE BONDING (grounding) of this controller and the enclosure in which it is installed shall be in accordance with National and local electrical codes. To minimize electrical noise and transients that may adversely affect the system, supplementary bonding of the controller enclosure to a local ground, using a No. 12 (4 mm2) copper conductor, is recommended.

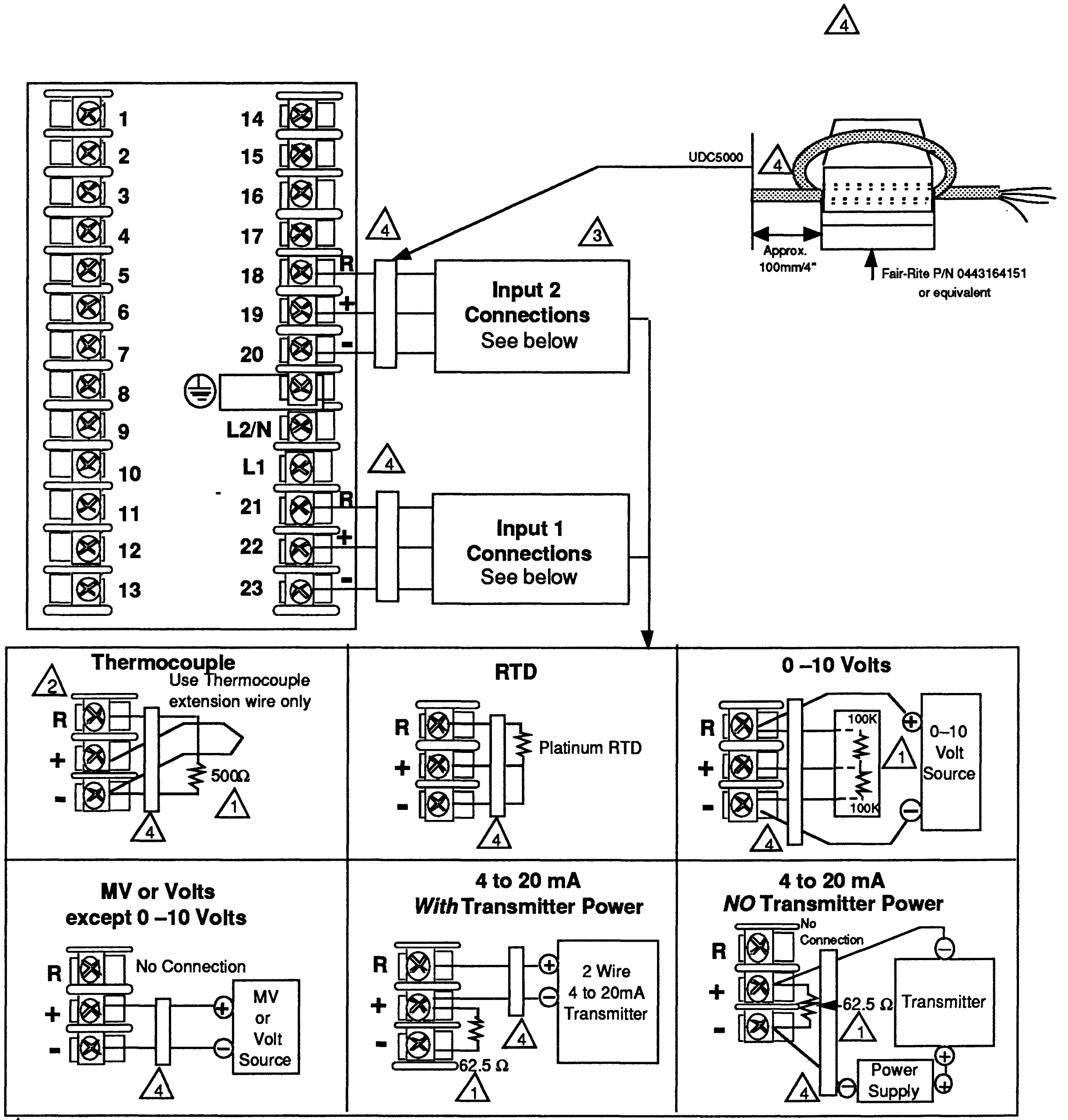
△4 Required for CE Mark Conformity - Kit supplied, Part No. 51197612-508, contains 8 ferrite filters.

Continued on next page

Input 1 and 2 connections

Figure 2-13 shows the wiring connections for Input #1 and #2

Figure 2-13 Input 1 and 2 Connections


4
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
L2/N
L1
21
22
23
R
+
-
UDC5000
Approx. 100mm/4"
Fair-Rite P/N 0443164151 or equivalent
3
Input 2 Connections See below
Input 1 Connections See below
Thermocouple
Use Thermocouple extension wire only
500Ω
2
RTD
Platinum RTD
0 –10 Volts
100K
100K
0–10 Volt Source
MV or Volts except 0 –10 Volts
No Connection
MV or Volt Source
4 to 20 mA With Transmitter Power
2 Wire 4 to 20mA Transmitter
62.5 Ω
4 to 20 mA NO Transmitter Power
No Connection
Transmitter
Power Supply

1. The 62.5 Ω load resistor for 4–20mA or the Voltage divider for 0–10 Volts or the 500 Ohm C/J compensation resistor are supplied with the controller when the input is specified. These items must be installed when you wire the controller before startup.
2. When installing the cold junction for a T/C input, remove the screw from "R" terminal and install the C/J assembly, connect tang to "–" terminal.
3. For Relative Humidity Option, use Input 2 as the Dry Bulb Input.
For Carbon Potential Option, use Input 2 as the Carbon Probe Input.

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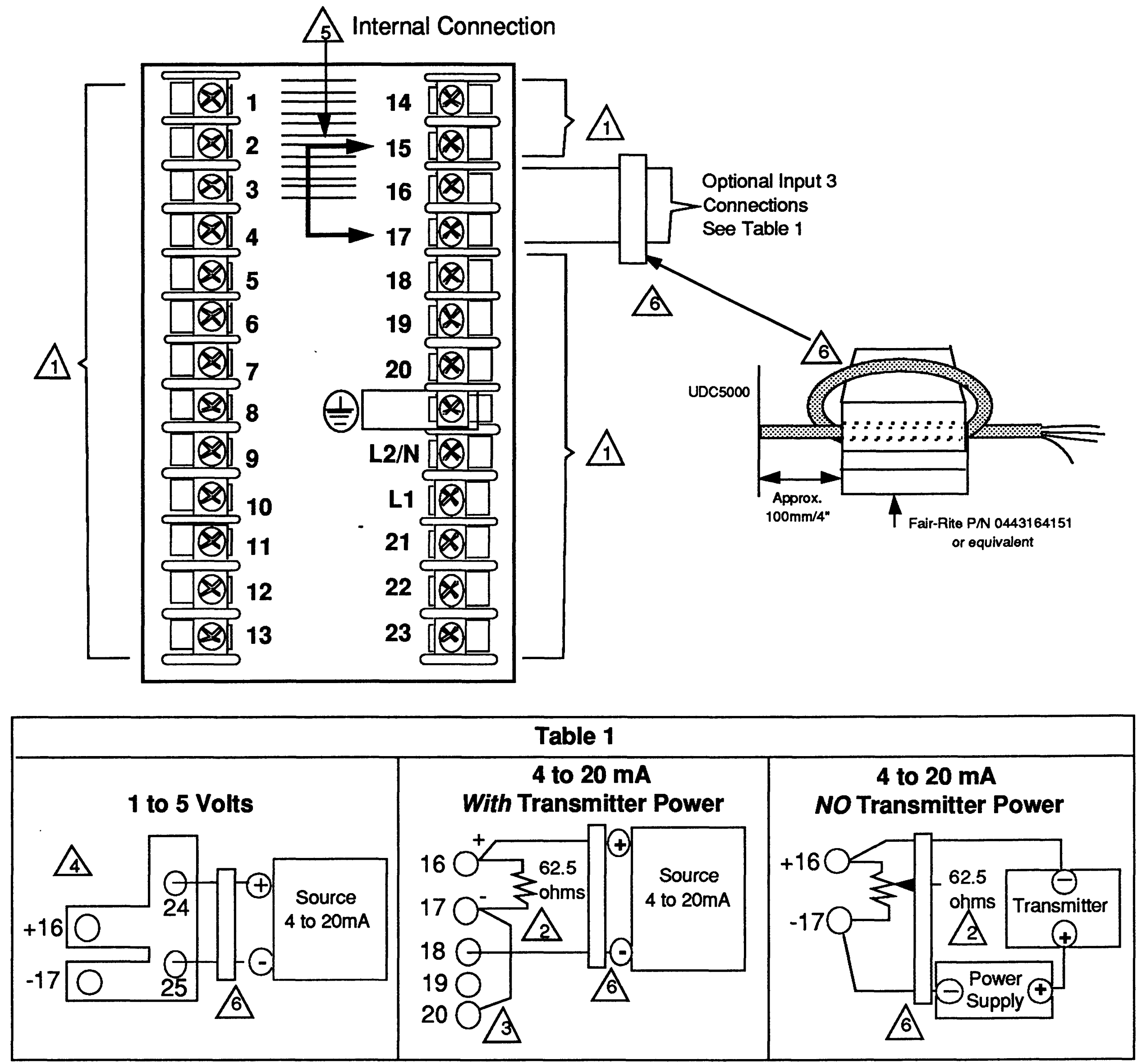
4. Required for CE Mark Conformity - Kit supplied, Part No. 51197612-508, contains 8 ferrite filters.

Continued on next page

2.7 Wiring Diagrams, Continued

Optional Input 3 Figure 2-14 shows the wiring connections for Optional Input 3.

Figure 2-14 Optional Input 3 Connections



1 See appropriate output wiring for connections.

2 Honeywell supplied 4 to 20 mA resistor, P/N 30754466-501.

3 Transmitter power for the third input is supplied from the second input, terminals #18 and #20. Therefore, when the third input has transmitter power, the second input, third input, and current output are not electrically isolated from each other.

4 Honeywell supplied 1 to 5 Volt printed wiring assembly, P/N 30755946-501.

5 The third input and the current output are not electrically isolated from each other. The negative terminal of the current output (#15) and the negative terminal of the third input (#17) are at the same potential.

6 Required for CE mark Compliance - Kit supplied Part Number 51197612-508 contains 8 Ferrite filters

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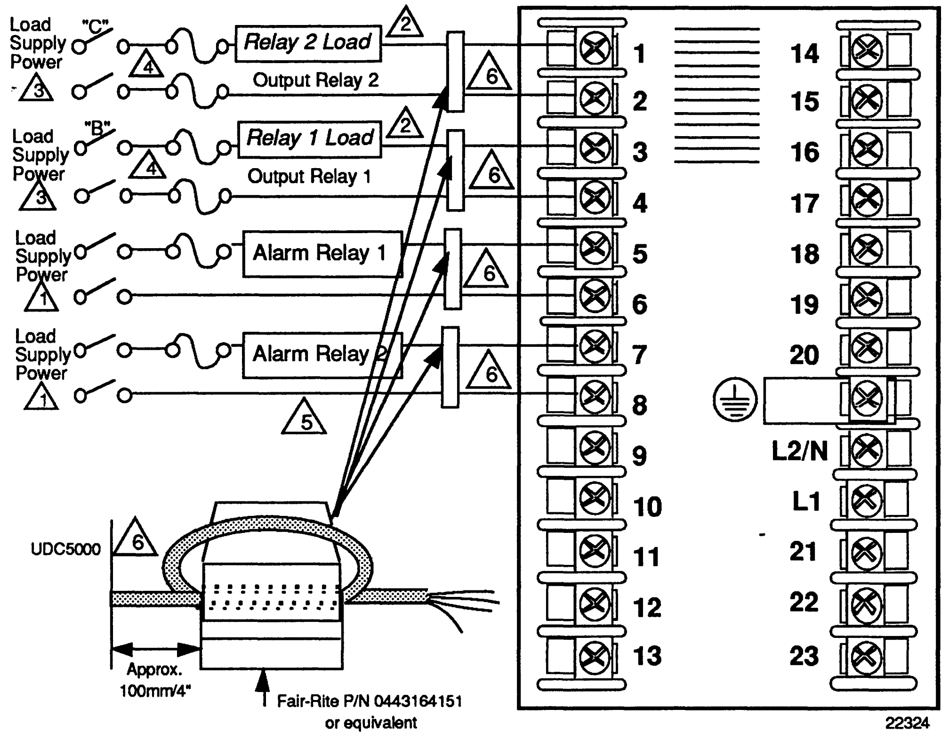
Continued on next page

Relay (Time Proportional)Output

Figure 2-15 shows the Output and Alarm wiring connections for models with Relay (Time Proportional) Output (Single Loop or Loop 1).

For Control and Alarm Relay Contact information, see Tables 2-4 and 2-5.

Figure 2-15 Relay (Time Proportional) Output Connections (Single Loop or Loop 1)



△1 UDCs are shipped with alarm relays having normally closed contacts configured. A N.O. or N.C. contact is selectable by means of a jumper on the controller board. See installation section for details. Each alarm is a SPDT relay rated at 5A for 120V or 240V.

△2 UDCs are shipped with control relays having normally open contacts configured. A N.O. or N.C. contact is selectable by means of a jumper on the controller board. See installation section for details. Each output is a SPDT relay rated at 50VA for 120V or 240V with maximum in rush factor of 10. Resistive ratings are 7A for 120 or 240V.

△3 Voltage must match load nameplate data.

△4 If power supply has ground neutral, connect leads "B" and "C" to neutral and omit fuses in neutral legs.

△5 Alarm 2 not available with Auxiliary Output, Communications, and Digital Inputs options

△6 Required for CE Mark Compliance - Kit supplied Part Number 51197612-508 contains 8 Ferrite filters

Continued on next page

Position Proportional Output or 3 Position Step

Figure 2-16 shows the Output and Alarm wiring connections for models with Position Proportional Output or 3 Position Step

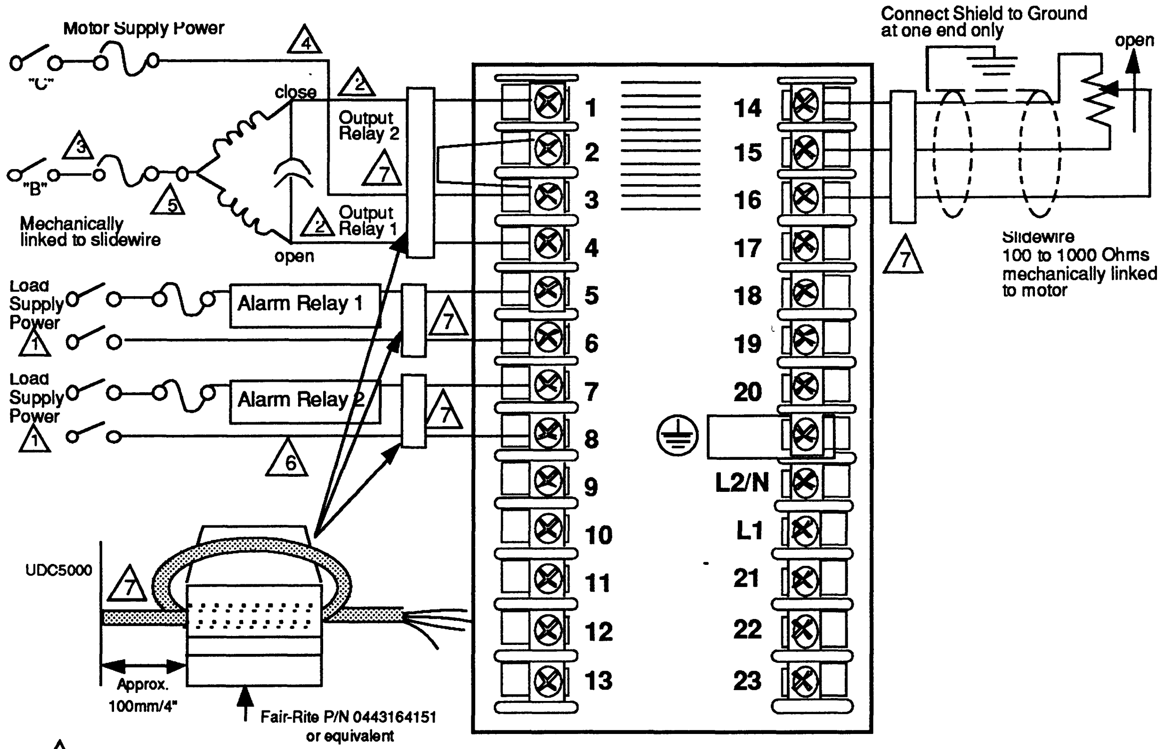
For Control and Alarm Relay Contact information, see Tables 2-4 and 2-5.

Calibration

Position Proportional Output or *Three Position Step* models must have the output calibrated after installation (see *Section 8—Position Proportional Output Calibration*) to ensure that the displayed output (slidewire position) agrees with the actual final control element position.

Three Position Step models only require that the motor time be entered. Full calibration is not required.

Figure 2-16 Position Proportional Output or 3 Position Step (Single Loop or Loop 1)



△1 UDCs are shipped with alarm relays having normally closed contacts configured. A N.O. or N.C. contact is selectable by means of a jumper on the controller board. See installation section for details. Each alarm is a SPDT relay rated at 5A for 120V or 240V.

△2 UDCs are shipped with control relays having normally open contacts configured. A N.O. or N.C. contact is selectable by means of a jumper on the controller board. See installation section for details. Each output is a SPDT relay rated at 50VA for 120V or 240V with maximum in rush factor of 10. Resistive ratings are 7A for 120 or 240V.

△3 If power supply has ground neutral, connect leads "B" and "C" to neutral and omit fuses in neutral legs.

△4 Voltage must match load nameplate data.

△5 Electrical noise suppression may be required. For additional wiring recommendations, refer to Appendix B "How to Apply Digital Instrumentation in Severe Electrical Noise Environments."

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△6 Alarm 2 not available with Auxiliary output, Communications, and Digital Inputs options.

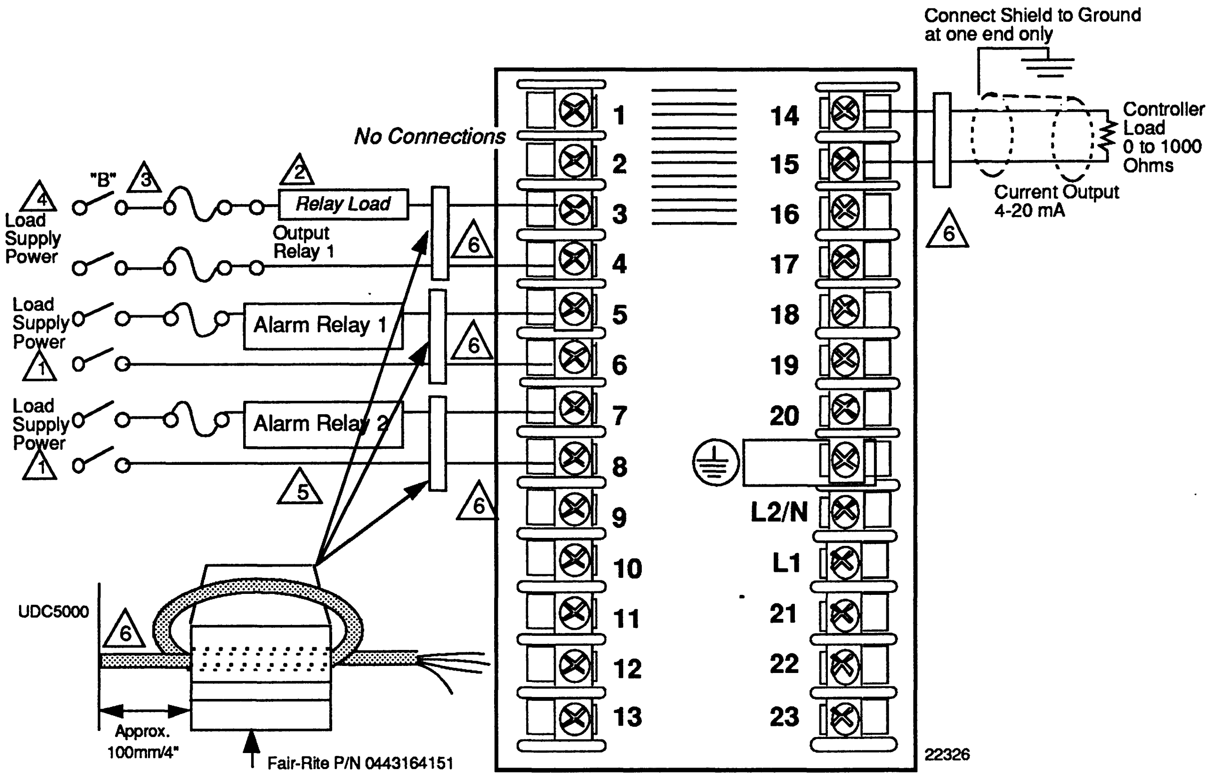
△7 Required for CE Mark Compliance - Kit supplied Part Number 51197612-508 contains 8 Ferrite filters

Continued on next page

Current proportional output

Figure 2-17 shows the wiring connections for Current Proportional Output (Single Loop or Loop 1).

Figure 2-17 Current Proportional Output Connections



⚠1 UDCs are shipped with alarm relays having normally closed contacts configured. A N.O. or N.C. contact is selectable by means of a jumper on the controller board. See installation section for details. Each alarm is a SPDT relay rated at 5A for 120V or 240V.

⚠2 UDCs are shipped with control relays having normally open contacts configured. A N.O. or N.C. contact is selectable by means of a jumper on the controller board. See installation section for details. Each output is a SPDT relay rated at 50VA for 120V or 240V with maximum in rush factor of 10. Resistive ratings are 7A for 120 or 240V.

⚠3 If power supply has ground neutral, connect leads "B" and "C" to neutral and omit fuses in neutral legs.

⚠4 Voltage must match load nameplate data.

⚠5 Alarm 2 not available with Auxiliary Output, Communications, and Digital Inputs options.

⚠6 Required for CE Mark Compliance - Kit supplied Part Number 51197612-508 contains 8 Ferrite filters

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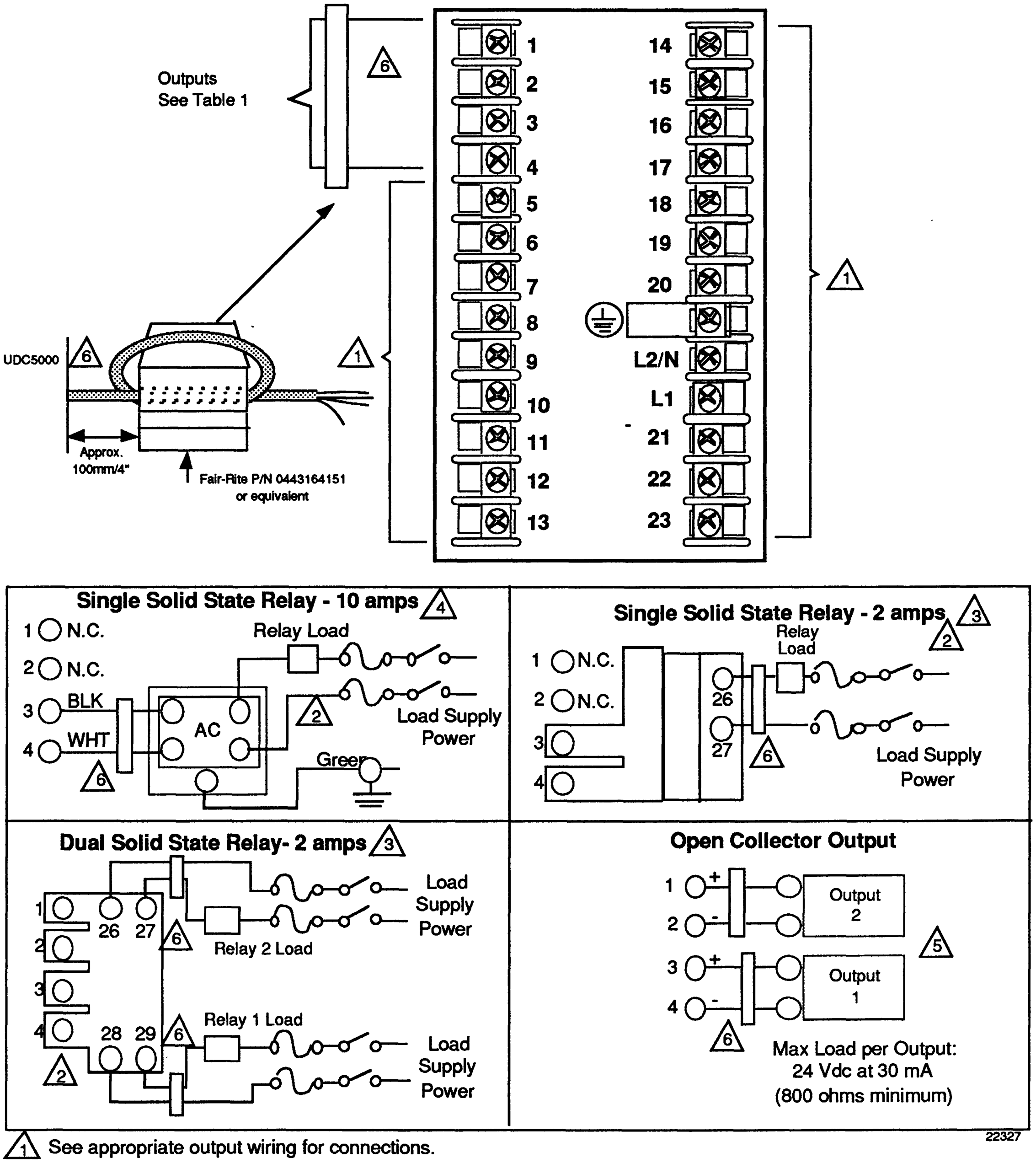
Open Collector or Solid State Relay Output Figure 2-18 shows the wiring connections for Open Collector or Solid State Relay Output.

Figure 2-18 Open Collector or Solid State Relay Output Connections



△1 See appropriate output wiring for connections.

△2 Single and Dual Solid State relays are Honeywell supplied.

△3 These Solid State Relays are rated at 3 amps at 25°C/77°Fderated linearly to 2 amps at 55°C/131°F.

△4 These Solid State Relays are rated at 15 amps at 25°C/77°F derated linearly to 10 amps at 55°C/131°F.

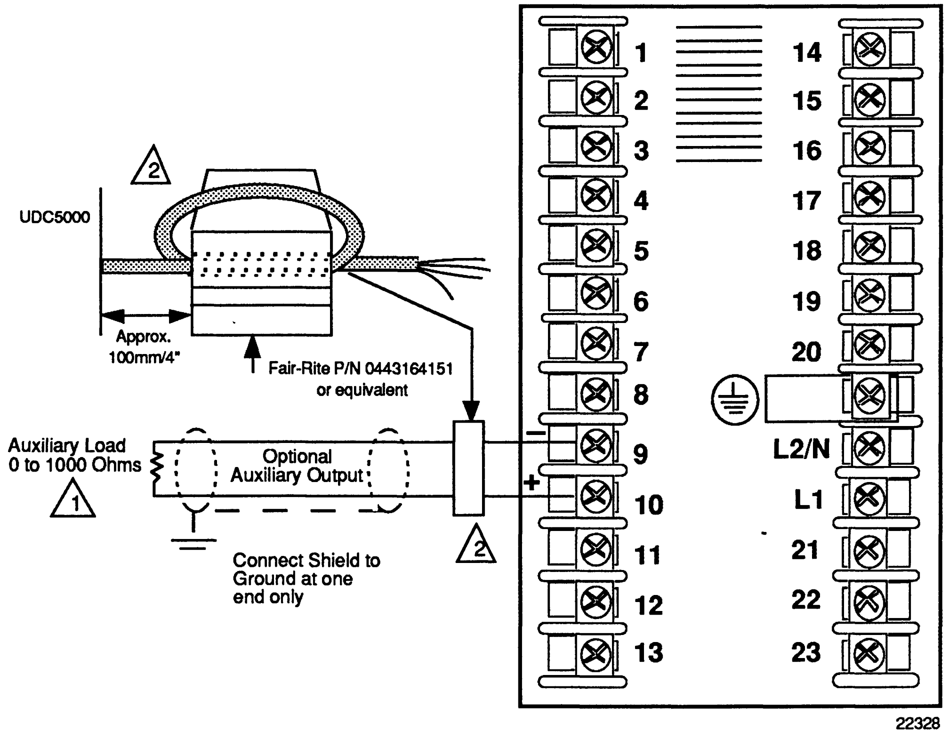
△5 **CAUTION** Open collector outputs are internally powered. Connecting an external supply will damage the controller.

△6 Required for CE Mark Compliance - Kit supplied Part Number 51197612-508 contains 8 Ferrite filters

Continued on next page

Auxiliary Output Figure 2-19 shows the wiring connections for an Auxiliary Output.

Figure 2-19 Auxiliary Output Connections


UDC5000
Approx. 100mm/4"
Fair-Rite P/N 0443164151 or equivalent
Auxiliary Load 0 to 1000 Ohms
Optional Auxiliary Output
Connect Shield to Ground at one end only
1 2 3 4 5 6 7 8 9 10 11 12 13
14 15 16 17 18 19 20 L2/N L1 21 22 23
−
+
22328

1. Auxiliary Output does not use these terminals when Communications and Remote Mode switching are present. Refer to Figure 2-22.

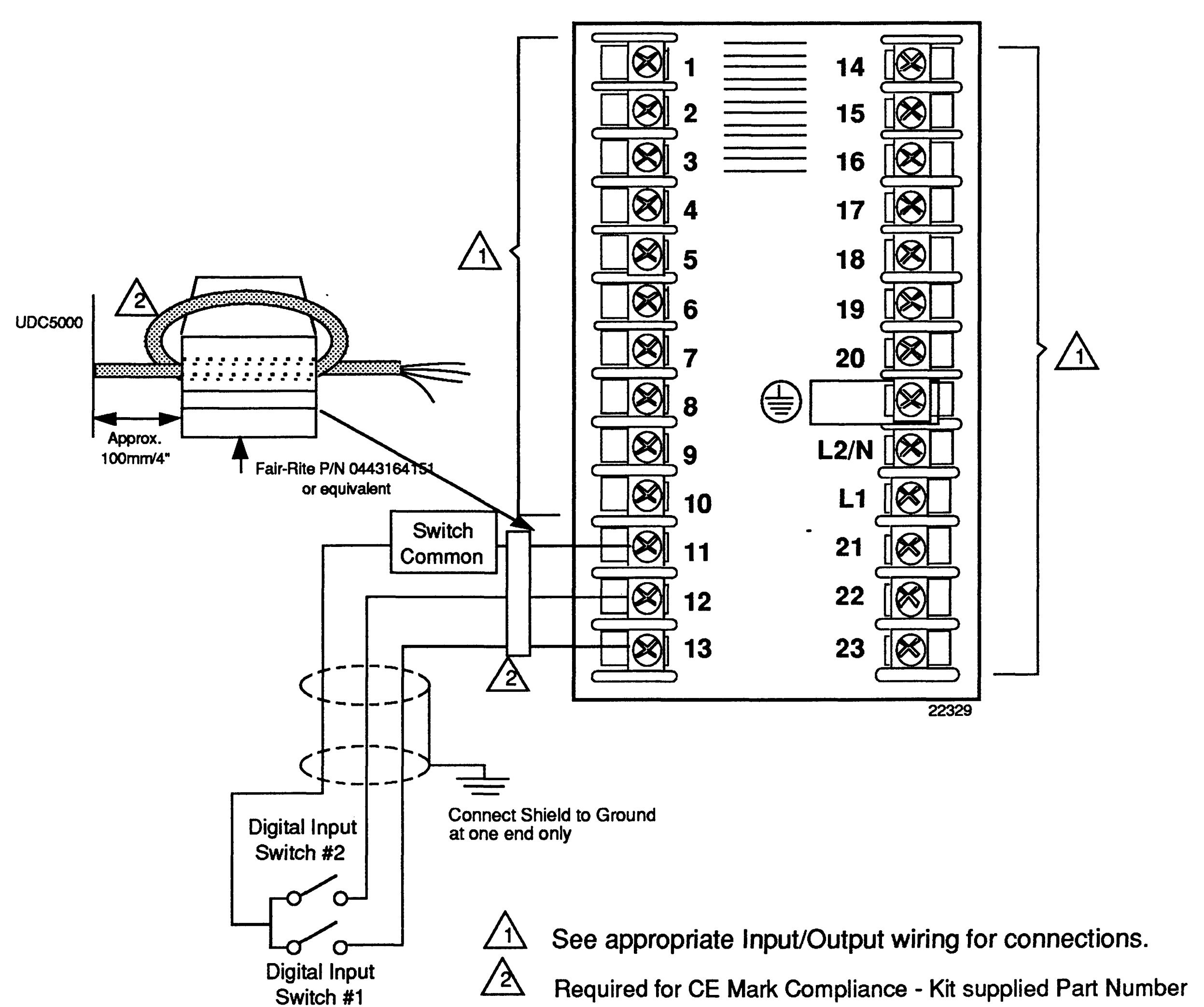
2. Required for CE Mark Compliance - Kit supplied Part Number 51197612-508 contains 8 Ferrite filters

Continued on next page

Digital Inputs

Figure 2-20 shows the wiring connections for Digital Inputs (without Communications Option).

Figure 2-20 Digital Input Connections (without Communications Option)



△1 See appropriate Input/Output wiring for connections.

△2 Required for CE Mark Compliance - Kit supplied Part Number 51197612-508 contains 8 Ferrite filters

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Continued on next page

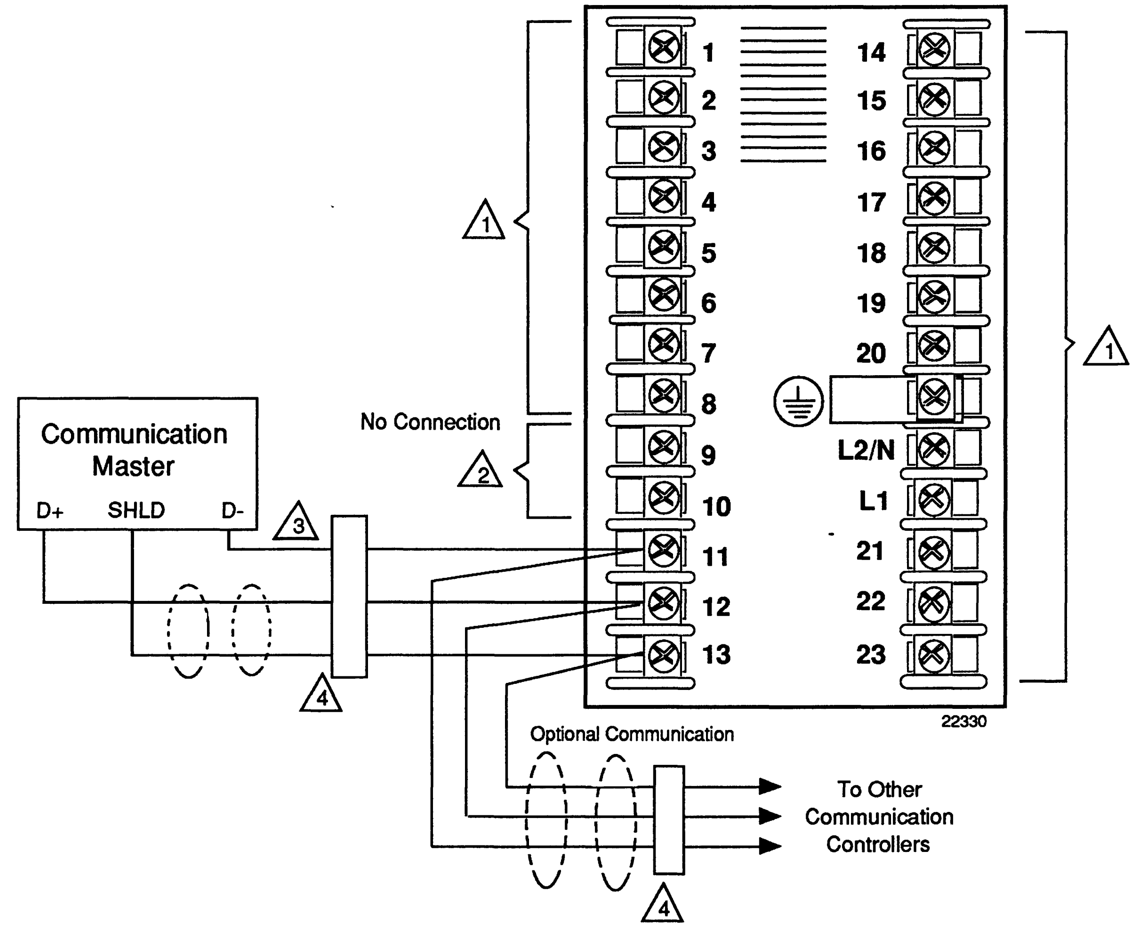
Communications option connections

There are two types of Communications option available:

- RS422/485 - also refer to Document # 51-51-25-35
- DMCS - also refer to Document # 82-50-10-26

Figure 2-21 shows the wiring connections for the Communications Option (without Digital Input Option).

Figure 2-21 Communications Option Connections (without Digital Input Option)



1 See appropriate output wiring for connections

2 Reserved for Auxiliary Output

3 Do not run these lines in the same conduit as AC power

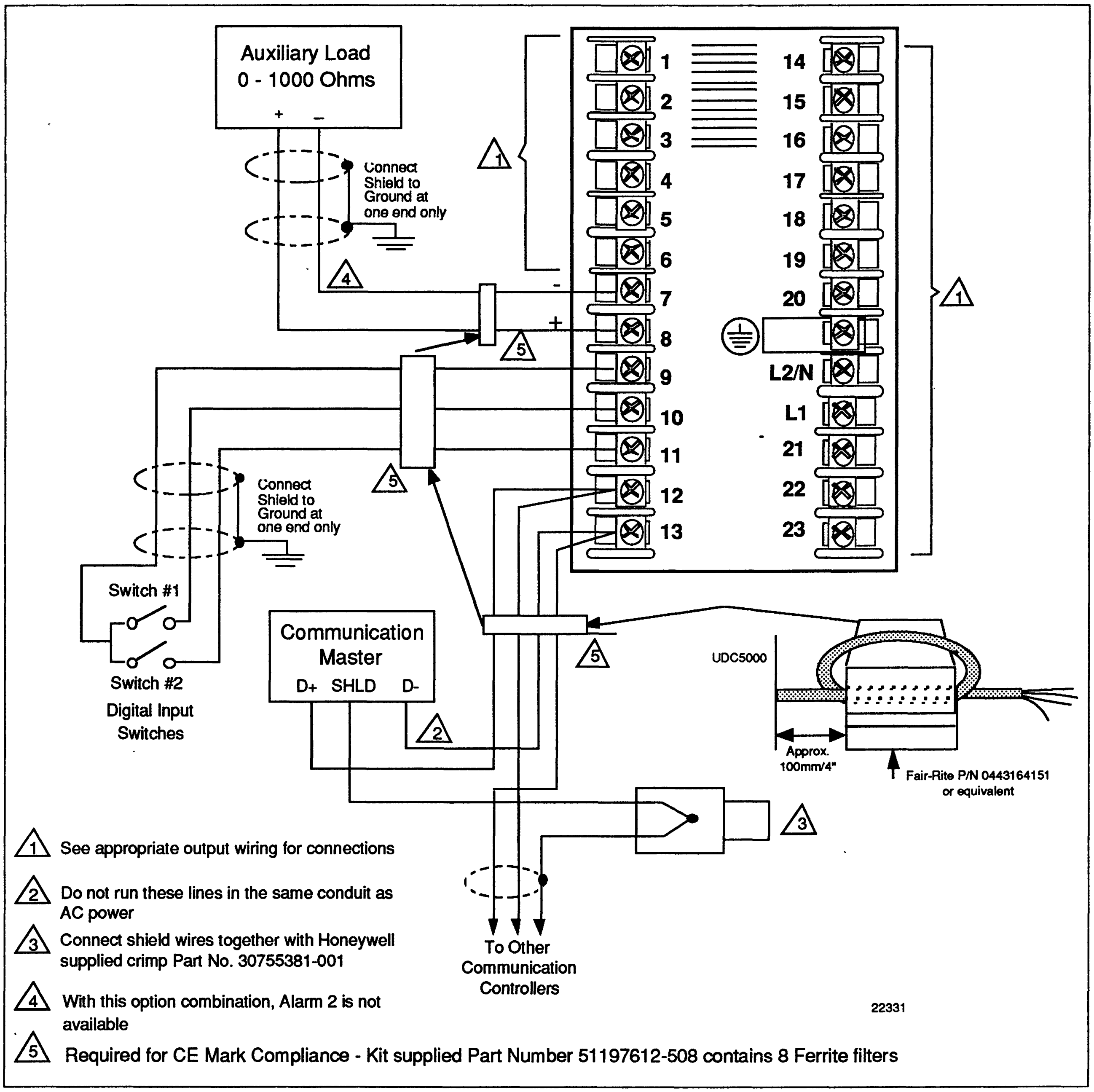
4 Required for CE Mark Compliance - Kit supplied Part Number 51197612-508 contains 8 Ferrite filters

Continued on next page

Communications and Digital Inputs with Auxiliary Output

Figure 2-22 shows the wiring connections for Communications, Digital Input, and Auxiliary Output.

Figure 2-22 Communications, Digital Input, and Auxiliary Output Connections



1 See appropriate output wiring for connections

2 Do not run these lines in the same conduit as AC power

3 Connect shield wires together with Honeywell supplied crimp Part No. 30755381-001

4 With this option combination, Alarm 2 is not available

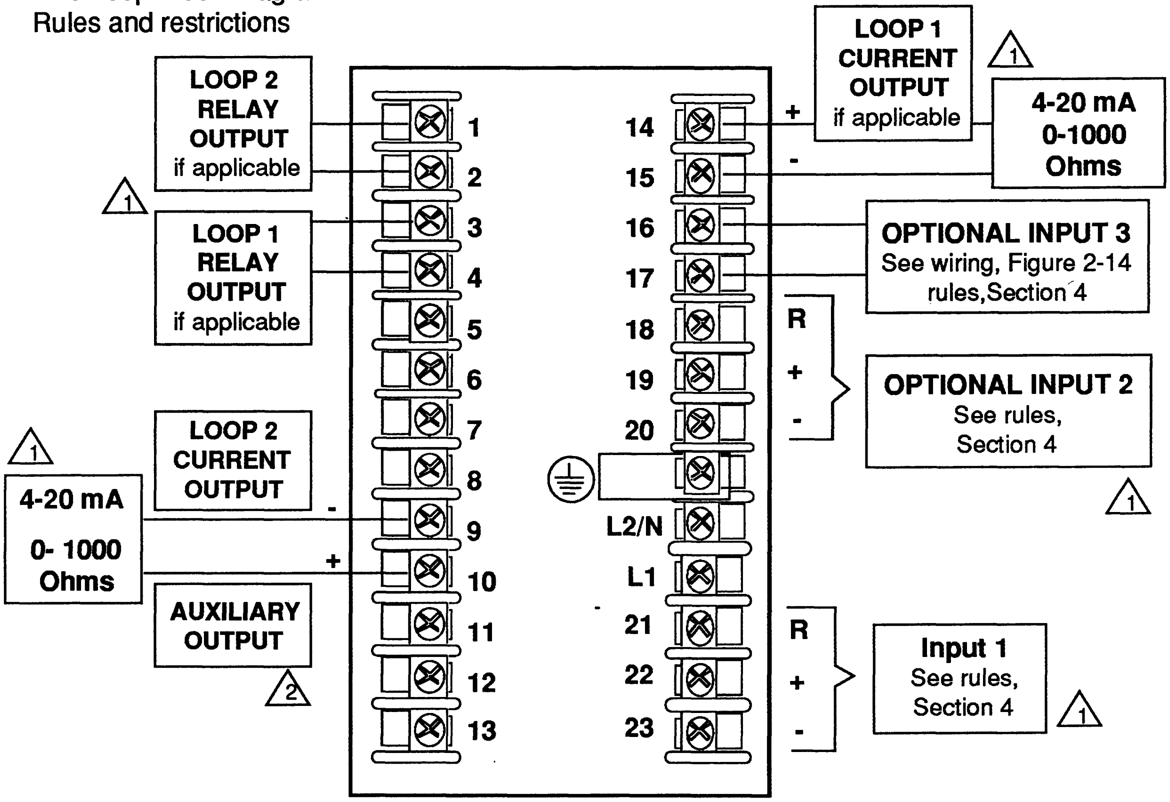
5 Required for CE Mark Compliance - Kit supplied Part Number 51197612-508 contains 8 Ferrite filters

Continued on next page

2 Loops of Control Figure 2-23 shows the wiring connections for 2 Loops of Control.

Figure 2-23 2 Loops of Control Connections

See Section 4 for:
Single Loop Block Diagram
Two Loop Block Diagram
Rules and restrictions



⚠1 See appropriate output wiring diagrams for connections.
- This drawing does not show wiring details. It shows possible output forms.

⚠2 Auxiliary output is dedicated to loop 2 output (out 2) for current output applications on loop 2.

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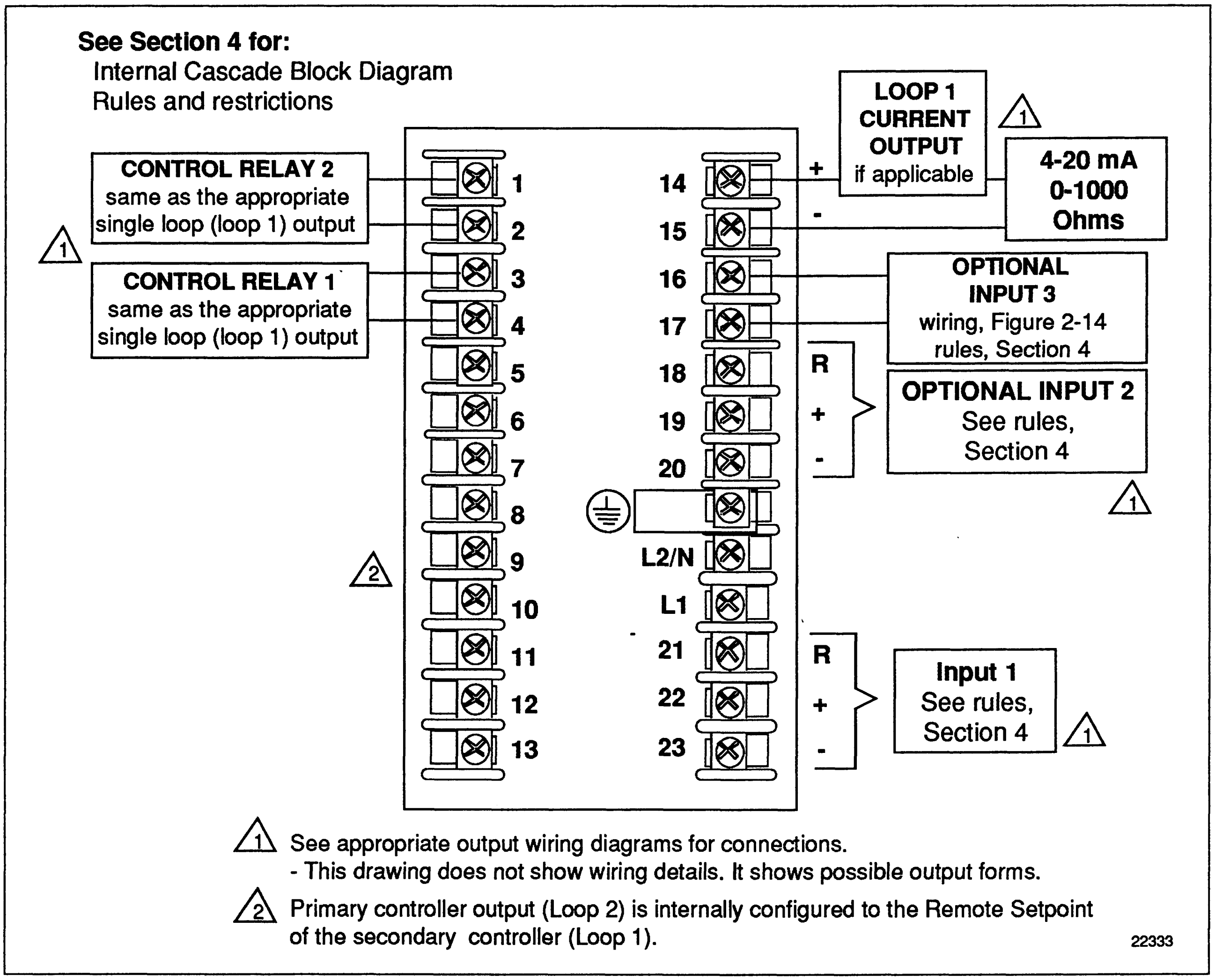
Continued on next page

Internal Cascade

Figure 2-24 shows the wiring connections for Internal Cascade Control connections.

Figure 2-24 Internal Cascade Control Connections



See Section 4 for:
Internal Cascade Block Diagram
Rules and restrictions
CONTROL RELAY 2 same as the appropriate single loop (loop 1) output
CONTROL RELAY 1 same as the appropriate single loop (loop 1) output
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
L2/N
L1
21
22
23
LOOP 1 CURRENT OUTPUT if applicable
4-20 mA 0-1000 Ohms
+
-
OPTIONAL INPUT 3 wiring, Figure 2-14 rules, Section 4
R
+
-
OPTIONAL INPUT 2 See rules, Section 4
R
+
-
Input 1 See rules, Section 4
1
2
22333

1 See appropriate output wiring diagrams for connections.
- This drawing does not show wiring details. It shows possible output forms.

2 Primary controller output (Loop 2) is internally configured to the Remote Setpoint of the secondary controller (Loop 1).

Section 3 – Configuration

3.1 Overview

Introduction

Configuration is a dedicated operation where you use straightforward keystroke sequences to select and establish (configure) pertinent control data best suited for your application.

What's in this section?

The table below lists the topics that are covered in this section.

Topic		Page
3.1	Overview	43
3.2	Configuration Prompts	44
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3.4	Configuration Tips	47
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3.15	Loop 1 Control Parameters Setup Group	61
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Prompts

To assist you in the configuration process, there are prompts that appear in the upper and lower displays. These prompts let you know what group of configuration data (Set Up prompts) you are working with and also, the specific parameters (Function prompts) associated with each group.

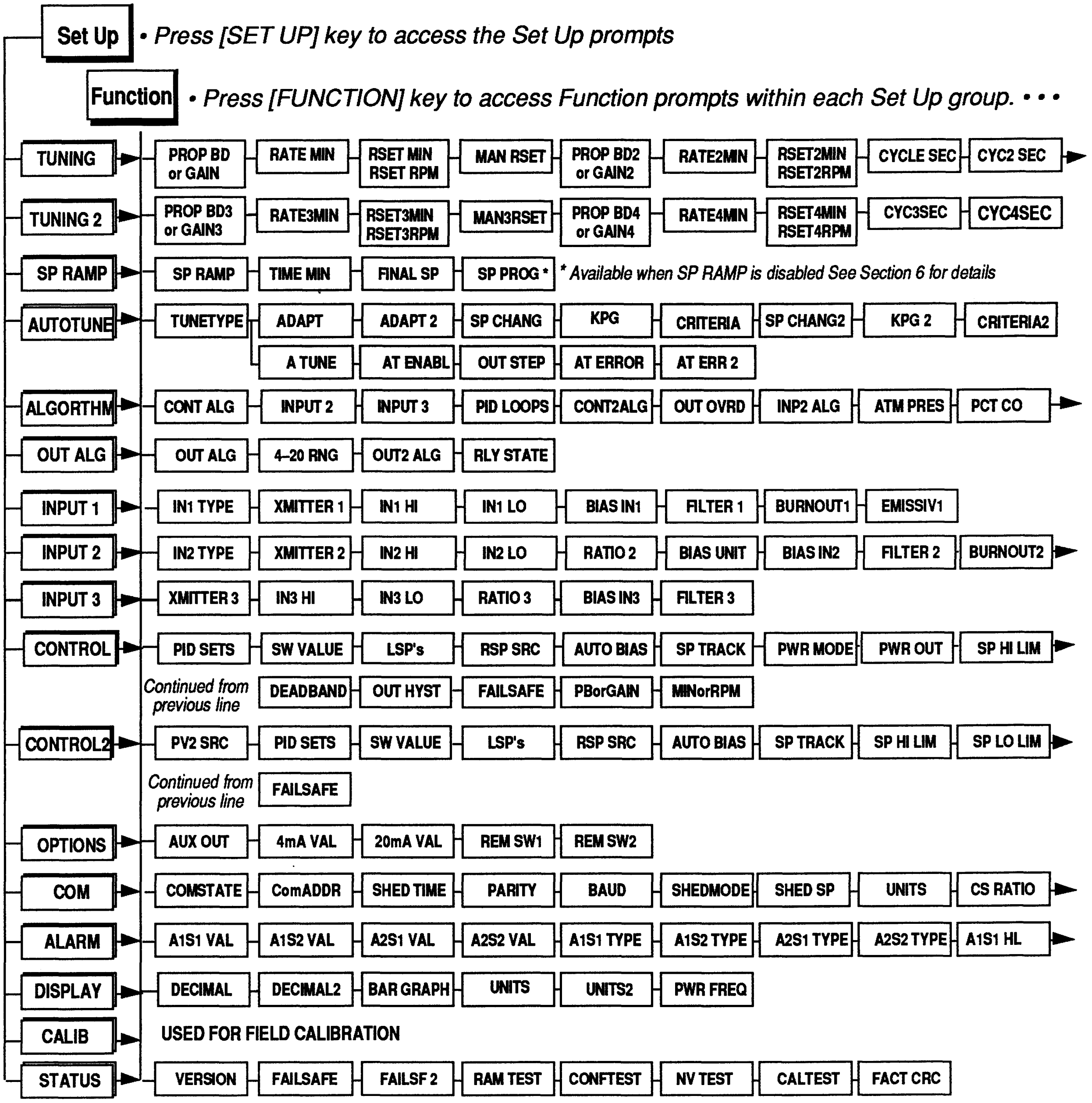
Figure 3-1 shows you an overview of the prompt hierarchy.
As you will see, the configuration data is divided into 15 main Set Up groups plus prompts for calibration and prompts that show the status of the continuous background tests that are being performed.

Continued on next page

3.2 Configuration Prompts

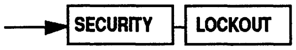
Diagram: prompt hierarchy Figure 3-1 shows an overview of the UDC5000 Set Up prompts and their associated Function prompts. - Read from left to right.

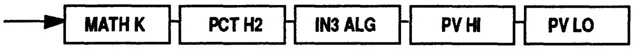
Figure 3-1 Overview of UDC5000 Prompt Hierarchy

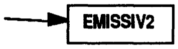


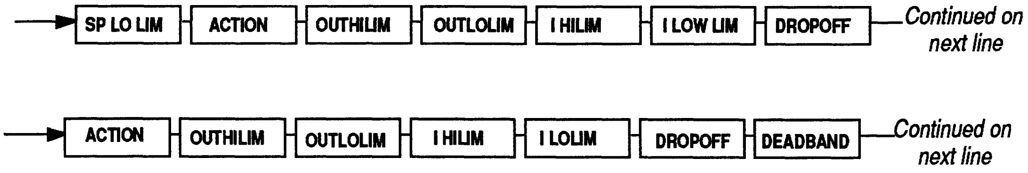
Continued on next page

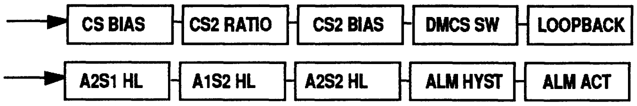
• • • Press [▲] or [▼] to change the value or selection of the Function prompt.











3.3 How To Get Started

Read the configuration tips

Read "*Configuration Tips*" shown on the next page. These tips will help you to easily and quickly accomplish the tasks at which you will be working when you configure your controller.

Read configuration procedure

Read "*Configuration Procedure*". This procedure tells you how to access the Set Up groups, and the Function parameters within each of the groups that are shown in the Prompt Hierarchy in Figure 3-1.

Set Up groups

The Set Up groups and Function parameters are listed in the order of their appearance. The list includes the name of the prompt, the range of setting or selections available, and the factory setting.

Parameter explanations or definitions

If you need a detailed explanation of any prompt listed, refer to ***Section 4 – Configuration Parameter Definitions.***
This section lists the Set Up and Function prompts, the selections or range of settings that you can make for each, plus a detailed explanation or definition of each parameter

Configuration record sheet

Located on the last page of this section is a "*Configuration Record Sheet*". When you make your configuration selections, record them on this sheet. Then you will have a record of how the controller was configured.

3.4 Configuration Tips

Introduction

Listed below in Table 3-1 are a few tips that will help you enter the configuration data more quickly.

Table 3-1 Configuration Tips

Function	Tip
Displaying Groups	Use the SET UP key to display the Set Up groups. The group titles are listed in this section in the order that they appear in the controller.
Displaying Functions	Use the FUNC key to display the individual parameters under each group. The prompts are listed in the order of their appearance in each group.
Scrolling	To get to a Set Up group prompt more quickly, hold the SET UP key in. To get to a Function prompt more quickly, hold the FUNC key in. The display will scroll through the parameters. **ATTENTION** The prompting scrolls at a rate of 2/3 seconds when the SET UP or FUNC key is held in. Also, ▲ ▼ keys will move group prompts forward or backward at a rate twice as fast.
Changing values quickly	When Changing the value of a parameter, you can adjust a more significant digit in the upper display by holding in one key ▲ or ▼ , and pressing the other ▲ or ▼ at the same time. The adjustment will move one digit to the left. Press the key again and you will move one more digit to the left.
Restoring to the original value	When you change the value or selection of a parameter while in Set Up mode and decide not to enter it, press RUN/HOLD key once, the original value or selection will be recalled.
Exiting SET UP mode	To exit Set Up mode, press the LOWR DISP key. This returns the display to the same state it was in immediately preceding entry into the Set Up mode.
Timing out from Set Up mode	If you are in Set Up mode and do not press any keys for one minute, the controller will time out and revert to the mode and display that was being used prior to entry into Set Up mode and stores any changes you have made.
Key Error	When a key is pressed and the prompt "KEY ERROR" appears in the lower display, it will be for one of the following reasons: • parameter not available • not in Set Up mode, press SET UP key first • key malfunction, do keyboard test (operation) • Individual key locked out

3.5 Configuration Procedure

Introduction

Each of the Set Up groups and their functions are pre-configured at the factory.

The factory settings are shown in the Set Up group tables that follow this procedure.

If you want to change any of these selections or values, follow the procedure in Table 3-2. This procedure tells you the keys to press to get to any Set Up group and any associated Function parameter prompt.

If you need a detailed explanation of any prompt, refer to *Section 4 – Configuration Parameter Definitions.*

Procedure

Follow the procedure listed in Table 3-2 to access the Set Up groups and Function prompts.

ATTENTION The prompting scrolls at a rate of 2/3 seconds when the SET UP or FUNC key is held in. Also, ▲ ▼ keys will move group prompts forward or backward at a rate twice as fast.

Table 3-2 Configuration Procedure

Step	Operation	Press	Result
1	Select Set Up mode	SET UP	Upper Display SET UP Lets you know you are in the configuration mode and a Set Up group title is being displayed in the lower display. Lower Display TUNING This is the first Set Up group title.
2	Select any Set Up group	SET UP	Successive presses of the SET UP key will sequentially display the other Set Up group titles shown in the prompt hierarchy in figure 3-1. You can also use the ▲ ▼ keys to scan the Set Up groups in both directions. Stop at the Set Up group title which describes the group of parameters you want to configure. Then proceed to the next step.
3	Select a Function Parameter	FUNC	Upper Display 1.0 Shows you the current value or selection for the first function prompt of the particular Set Up group that you have selected. Lower Display GAIN Shows the first Function prompt within that Set Up group. Example displays show Set Up group “Tuning”, Function prompt “Gain” and the value selected.

Table 3-2 continued on next page

Procedure (continued)

Table 3-2 Configuration Procedure, continued

Step	Operation	Press	Result
4	Select other Function Parameters	FUNC	Successive presses of the FUNC Key will sequentially display the other function prompts of the Set Up group you have selected. Stop at the function prompt that you want to change, then proceed to the next step.
5	Change the value or selection	▲ or ▼	These keys will increment or decrement the value or selection that appears for the function prompt you have selected. See "Configuration Tips" for instructions to increase or decrease value quickly. Change the value or selection to meet your needs. If the display flashes, you are trying to make an unacceptable entry.
6	Enter the value or selection	FUNC or SET UP	This key selects another function prompt. This key selects another Set Up group. The value or selection you have made will be entered into memory after another key is pressed.
7	Exit Configuration	LOWR DISP	This exits configuration mode and returns the controller to the same state it was in immediately preceding entry into the Set Up mode. It stores any changes you have made.

3.6 Tuning Parameters Set Up Group

Introduction

The Tuning Set Up group contains the Function parameters that will allow your controller to respond correctly to changes in process variable or setpoint.

You can start with predetermined values but you will have to watch your process to determine how to modify them.

If you have the Autotune/Adaptive Tune option, this will automatically select Gain, Rate, and Reset values.

Set this group last

Because this group contains functions that have to do with Security and Lockout, it is best to configure this group last, after all the other configuration data has been loaded.

Duplex Heat Cool

See Table 4-2 in *Section 4 - Prompt Definitions* for Duplex Heat/Cool designations.

Continued on next page

Function prompts

Table 3-3 lists all the function prompts in the Tuning Set Up group. How the "Algorithm" and "Control" Set Up groups are configured determines which prompts will appear.

Table 3-3 Tuning Group Function Prompts

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
PROP BD or **GAIN**	Proportional Band, or Gain	0.1 to 9999 (PB) 0.1 to 1000 (Gain)	-- 1.0
RATE MIN	Rate in Minutes	0.08 to 10.00 minutes (0.00=Off)	0.00
RSET MIN	Reset in minutes/repeat	0.02 to 50.00	1.0
RSET RPM	Reset in repeats/minute	0.02 to 50.00	1.0
MAN RSET	Manual Reset	–100 to 100% Output	0
PROP BD2 or **GAIN 2**	Proportional Band 2, or Gain 2	0.1 to 9999 (PB) 0.1 to 1000 (Gain)	-- 1.0
RATE2MIN	Rate 2 in Minutes	0.08 to 10.00 minutes (0.00=Off)	0.00
RSET2MIN	Reset 2 in minutes/repeat	0.02 to 50.00	1.0
RSET2RPM	Reset 2 in repeats/minute	0.02 to 50.00	--
CYC SEC	Cycle Time (Heat)	1 to 120 seconds	4
CYC2 SEC	Cycle Time 2 (Cool)	1 to 120 seconds	4
SECURITY	Security Code	1 to 4095	0
LOCKOUT	Configuration Lockout	NONE CALIB +CONF +VIEW MAX	CALIB

Continued on next page

3.7 Tuning 2 Parameters Set Up Group (Cascade or 2 Loop)

Function prompts

Table 3-4 lists all the function prompts in the Tuning 2 Set Up group. This group is only displayed if the controller is configured for "Cascade" or "2 Loop" control at prompt "PV2SRC"

Table 3-4 Tuning 2 Group Function Prompts

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
PROPBD3 or **GAIN3**	Proportional Band 3, or Gain 3	0.1 to 9999 (PB) 0.1 to 1000 (Gain)	-- 1.0
RATE 3 MIN	Rate 3 in Minutes	0.08 to 10.00 minutes (0.00=Off)	0.00
RSET3MIN	Reset 3 in minutes/repeat	0.02 to 50.00	1.0
RSET3RPM	Reset 3 in repeats/minute	0.02 to 50.00	--
MAN 3RSET	Manual Reset 3	–100 to 100% Output	50.0
PROPBD4 or **GAIN 4**	Proportional Band 4, or Gain 4	0.1 to 9999 (PB) 0.1 to 1000 (Gain)	-- 1.0
RATE4MIN	Rate 4 in Minutes	0.08 to 10.00 minutes (0.00=Off)	0.00
RSET4MIN	Reset 4 in minutes/repeat	0.02 to 50.00	1.0
RSET4RPM	Reset 4 in repeats/minute	0.02 to 50.00	--
CYC 3SEC	Cycle Time 3(Heat)	1 to 120 seconds	4
CYC 4SEC	Cycle Time 4 (Cool)	1 to 120 seconds	4

3.8 SP Ramp/Program Set Up Group

Single Setpoint Ramp

The Setpoint Ramp Set Up group contains the Function parameters that let you to configure a single set point ramp to occur between the current local setpoint and a final setpoint over a time interval (SP RAMP).

Setpoint Program

The Setpoint Ramp Set Up group also contains function parameters that let you configure a specific Ramp/Soak Program. SP RAMP must be disabled to allow SP PROG. *See Section 6 - Setpoint Ramp/Soak Programming for details.*

Function prompts

Table 3-5 lists all the function prompts in the SP RAMP Set Up group.

Table 3-5 SP Ramp Group Function Prompts

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
SP RAMP	Single Setpoint Ramp Selection	DISABL ENABLE ENABL2 ENABL12	DISABL
TIME MIN	Single Setpoint Ramp Time	0 to 255 minutes	3
FINAL SP	Single Setpoint Final Setpoint	Enter a value within the setpoint limits	1000
SP PROG (See Section 6)	Setpoint Ramp/Soak Program	DISABL ENABLE ENABL2 ENABL12	DISABL

3.9 Autotune/Adaptive Tune Set Up Group

Adaptive Tune

Adaptive Tune continuously adjusts the PID parameters in response to setpoint changes and/or Process Variable disturbances. You can select tuning on minimum setpoint changes of 5% up to 15% span. Perform adaptive tuning after you have configured the controller.
Adaptive Tune does not work with 3 Position Step Control algorithm.

Autotune

Autotune automatically calculates PID tuning cocnstants on demand based on an Output Step introduced onto the process. You can select an Output Step size of from –100 to +100% of output.

Function prompts

Table 3-6 lists all the function prompts in the "AUTOTUNE" Set Up group.

Table 3-6 Autotune Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
TUNETYPE	Autotune Type	ADAPT* A TUNE **	A TUNE
ADAPT	Adaptive Tune - LOOP 1	DISABLE SPoNLY SP + PV	DISABLE
ADAPT2	Adaptive Tune - LOOP 2	DISABLE SPoNLY SP + PV	DISABLE
SP CHANG	Setpoint Change Value	5 to 15% Input Span	10
KPG	Process Gain Value	0.10 to 10.00	1.0
CRITERIA	Tuning Criteria - Loop 1	NORMAL FAST	--
SP CHANG2	Setpoint Change Value - Loop 2	5 to 15% Input Span	10
KPG 2	Process Gain - Loop 2	0.10 to 10.00	1.0
CRITERIA2	Tuning Criteria - Loop 2	NORMAL FAST	--
A TUNE	Autotune	DISABL A STEP M STEP A STEP2 M STEP2	DISABLE
OUT STEP	Output Step Size	–100 to +100% of Output in 1% increments	--
AT ERROR **or** **AT ERR 2** (depending on Loop)	Autotune Error codes	Read Only NONE -I-LIM OUT LIM -P-LIM DUPLIM ABORT ALARM 1 INPUT LOW PV RAMP ID FAIL REM SW	- -

3.10 Algorithm Data Set Up Group

Introduction

This data deals with various algorithms residing in the controller: Control Algorithms, Input algorithms, Enabling the 2nd or 3rd input, Selecting the Number of PID Loops, Control algorithm for Loop 2, and Output Override.

Function prompts

Table 3-7 lists all the function prompts in the "ALGORITHM" Set Up group.

Table 3-7 Algorithm Group Function Prompts

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
CONT ALG	Control Algorithm	ON-OFF PID A PID B PD+MR 3PSTEP	PID A
INPUT 2	Input 2 selection	ENABL DISABL	ENABL
INPUT 3	Input 3 selection	ENABL DISABL	ENABL
PID LOOPS	PID Loop Selection	1 LOOP 2 LOOPS CASCAD	1 or 2
CONT2 ALG	Control 2 Algorithm	PID A PID B PD+MR	PID A
OUT OVRD	Output Override Select	DISABLE HI SEL LO SEL	DISABL
IN P2 ALG	Input 2 Algorithm (formulas are located in Section 4)	NONE W AVG REL HUM FFWRD ADDER SUBTRC SUMwRB HI SEL LO SEL HI SEL+ LO SEL+ √ MU DIV √ MUL T MU DIV MULT FFWRD2 CARB A CARB B CARB C CARB D FCC OXYGEN DEW PT	NONE
ATM PRES	Atmospheric Pressure Compensation	590.0 to 760.0	760.0

Table 3-7 continued on next page

Function prompts (cocntinued)

Table 3-7 Algorithm Group Function Prompts, continued

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
PC CO	Percent Carbon Monoxide	0.02 to 0.350(%CO)	0.2
MATH K	Weighted Average Ratio or K Constant for Math Selections	0.001 to 9.999	1.00
PCT H_2	Hydrogen Content	1 to 99(%H_2)	--
INP3 ALG	Input 3 Algorithm	NONE FFWRD SUMwRB HI SEL+ LO SEL+ FFWRD2	NONE
PV HI	Process Variable High Range for second and third input algorithms	–999 to 9999	1000
PV LO	Process Variable Low Range for second and third input algorithms	–999 to 9999	0

3.11 Output Algorithm Parameters Set Up Group

Introduction

This data deals with various Output algorithms that are available for use in the controller. It also lists the Relay State, and the Current Duplex functionality.

Function prompts

Table 3-8 lists all the function prompts in the "OUT ALG" Set Up group.

Table 3-8 Output Algorithm Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
OUT ALG	Loop 1 Output Algorithm	TIME CURRNT POSITN TIME D CUR D CUR TI TI CUR	CURRENT
4–20 RNG	Current Duplex Range	100PCT 50PCT	100PCT
OUT2 ALG	Loop 2 Output Algorithm	NONE TIME CURRNT CUR D CUR TI TI CUR	TIME
RLY STATE	Duplex Relay Status at 0% Output	1OF 2OF 1ON 2OF 1OF 2ON 1ON 2ON	1OF 2ON

3.12 Input 1 Parameters Set Up Group

Introduction

This data deals with various parameters required to configure Input 1; actuation, transmitter characterization, high and low range values in engineering units, bias, filter, and burnout.

Function prompts

Table 3-9 lists all the function prompts in the "INPUT 1" Set Up group.

Table 3-9 Input 1 Set Up Groups Function Prompts

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
INP1 TYP	Input 1 Type	B EH EL JH JL KH KL NNMH NNML NIC R S TH TL WH WL 100 PT 100 LO 100 RH 200 PT 500 PT RADIAM 4–20MA 0–10MV 10–50MV 1–5V 0–10V	0–10MV
XMITTER1	Transmitter Characterization	B EH EL JH JL KH KL NNMH NNML NIC R S TH TL WH WL 100 PT 100 LO 100 RH 200 PT 500 PT LINEAR SQROOT	LINEAR
IN1 HI	Input 1 High Range Value (Linear Inputs only	–999 to 9999 in engineering units	1000
IN1 LO	Input 1 Low Range Value (Linear Inputs only)	–999 to 9999 in engineering units	0
BIAS IN 1	Input 1 Bias Value	–999 to 9999.	0
FILTER 1	Input 1 Filter	0 to 120 seconds	0
BURNOUT 1	Sensor Break Protection	NONE UP DOWN	None
EMISSIVITY1	Emissivity	0.10 to 1.00	1.00

3.13 Input 2 Parameters Set Up Group

Introduction

This data deals with various parameters required to configure Input 2; actuation, transmitter characterization, high and low range values in engineering units, ratio, bias, filter, burnout, and emissivity.

Function prompts

Table 3-10 lists all the function prompts in the “INPUT 2” Set Up group.

Table 3-10 Input 2 Set Up Groups Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
INP2 TYP	Input 2 Type	B EH EL JH JL KH KL NNMH NNML NIC R S TH TL WH WL 100 PT 100 LO 100 RH 200 PT 500 PT RADIAM 4–20MA 0–10MV 10–50MV 1–5V 0–10V CARBON OXYGEN	0–10MV
XMITTER2	Transmitter Characterization	B EH EL JH JL KH KL NNMH NNML NIC R S TH TL WH WL 100 PT 100 LO 100 RH 200 PT 500 PT LINEAR SQROOT	LINEAR
IN2 HI	Input 2 High Range Value (Linear Inputs only	–999 to 9999 in engineering units	1000
IN2 LO	Input 2 Low Range Value (Linear Inputs only)	–999 to 9999 in engineering units	0
RATIO 2	Ratio 2	–20.00 to 20.00	1.00
BIASUNIT	Bias Units	ENG PERCNT	ENG
BIAS IN2	Bias Input 2 Value	–999 to 9999 Engr. Units –999 to 2000% of Input Span	0
FILTER 2	Input 2 Filter	0 to 120 seconds	0
BURNOUT 2	Sensor Break Protection	NONE UP DOWN	None
EMISSIVITY2	Emissivity	0.10 to 1.00	1.00

3.14 Input 3 Parameters Set Up Group

Introduction

This data deals with various parameters required to configure Input 3; transmitter characterization, high and low range values in engineering units, ratio, bias, and filter.

Function prompts

Table 3-11 lists all the function prompts in the INPUT 3 Set Up group.

Table 3-11 Input 3 Set Up Groups Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
XMITTER3	Transmitter Characterization	B EH EL JH JL KH KL NNMH NNML NIC R S TH TL WH WL 100 PT 100 LO 100 RH 200 PT 500 PT LINEAR SQROOT	LINEAR
IN3 HI	Input 3 High Range Value	–999 to 9999 in engineering units (Adjustable for linear inputs only)	1000
IN3 LO	Input 3 Low Range Value	–999 to 9999 in engineering units (Adjustable for linear inputs only)	0
RATIO 3	Input 3 Ratio Value	–20.00 to 20.00	1.0
BIAS IN3	Input 3 Bias Value	–999 to 9999 in engineering units	0
FILTER 3	Input 3 Filter	0 to 120 seconds 0 = No Filter	0

3.15 Loop 1 Control Parameters Set Up Group

Introduction

The functions listed in this group define how the Single Loop process controller or Loop 1 of a Two Loop process controller will control the process.

Function prompts

Table 3-12 lists all the function prompts in the "CONTROL" Set Up group.

Table 3-12 Control Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
PID SETS	Tuning Parameter Sets	1 ONLY 2KEYBD 2PV SW 2SP SW	1 ONLY
SW VALUE	Automatic Switchover Value	Value in Engineering Units within Input Range	0.00
LSP'S	Local Setpoint Source	1 ONLY TWO THREE	1 ONLY
RSP SRC	Remote Setpoint Source	NONE IN 2 IN 3	NONE
AUTO BIAS	Automatic Bias	ENABLE DISABLE	DISABLE
SP TRACK	Local Setpoint Tracking	NONE PV RSP	NONE
PWR MODE	Power Up Mode Recall	MANUAL A M SP A M LSP	A or M SP
PWR OUT	Power Up Output Select	LAST F'SAFE	F'SAFE
SP HILIM	Setpoint High Limit	0 to 100% of PV in engineering units	1000
SP LOLIM	Setpoint Low Limit	0 to 100% of PV in engineering units	0

Table 3-12 continued on next page

Function prompts, continued

Table 3-12 lists all the function prompts in the “CONTROL” Set Up group.

Table 3-12 Control Group Function Prompts, continued

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
ACTION	Control Output Direction	DIRECT REVERSE	REVERSE
OUTHILIM	High Output Limit	–5.0 to 105.0% of output	100.0
OUTLOLIM	Low Output Limit	–5.0 to 105.0% of output	0.0
I HI LIM	High Reset Limit	Within the range of the output limits	100.0
I LO LIM	Low Reset Limit	Within the range of the output limits	0.0
DROPOFF	Controller Dropoff Value	–5.0 to 105.0% of output	0.0
DEADBAND	Output Relay Deadband	*Duplex: only* –5.0 to 25.0% *All others* 0.0 to 25.0%	1.0
OUT HYST	Output Relay Hysteresis	0.0 to 5.0% of PV Span for On/Off control	0.5
FAILSAFE	Failsafe Output Value	Set within the range of the output limits. 0 to 100%	0.0
PBorGAIN	Proportional Band or Gain Units	PB PCT GAIN	GAIN
MINorRPM	Reset Units	RPM MIN	MIN

3.16 Loop 2 Control Parameters Set Up Group

Introduction

The functions listed in this group define how Loop 2 of a Two Loop process controller will control the process.

Function prompts

Table 3-13 lists all the function prompts in the "CONTROL2" Set Up group.

Table 3-13 Control2 Group Function Prompts

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
PV 2 SRC	Process Variable Source	IN 1 IN 2 IN 3	INPUT 2
PID SETS	Tuning Parameter Sets	1 ONLY 2KEYBD 2PV SW 2SP SW	1 ONLY
SW VALUE	Automatic Switchover Value	Value in Engineering Units within Input Range	0.00
LSP'S	Local Setpoint Source	1 ONLY TWO THREE	1 ONLY
RSP SRC	Remote Setpoint Source	NONE IN 2 IN 3	NONE
AUTO BIAS	Automatic Bias	ENABLE DISABLE	DISABLE
SP TRACK	Local Setpoint Tracking	NONE PV RSP	NONE
SP HILIM	Setpoint High Limit	0 to 100% of PV in engineering units	100.0
SP LOLIM	Setpoint Low Limit	0 to 100% of PV in engineering units	0.0

Table 3-13 continued on next page

Function prompts, continued

Table 3-13 lists all the function prompts in the "CONTROL2" Set Up group.

Table 3-13 Control2 Group Function Prompts, continued

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
ACTION	Control Output Direction	DIRECT REVERSE	REVERSE
OUTHILIM	High Output Limit	–5.0 to 105.0% of output	100.0
OUTLOLIM	Low Output Limit	–5.0 to 105.0% of output	0
I HI LIM	High Reset Limit	Within the range of the output limits	100.0
I LO LIM	Low Reset Limit	Within the range of the output limits	0.0
DROPOFF	Controller Dropoff Value	–5.0 to 105.0% of output	0.0
DEADBAND	Output Relay Deadband	*Duplex: only* –5.0 to 25.0% *All others* 0.0 to 25.0%	1.0
FAILSAFE	Failsafe Output Value	Set within the range of the output limits. 0 to 100%	0.0

3.17 Options Set Up Group

Introduction

This data deals with data that covers the Auxiliary Output and the Two Remote Switch selections. If your controller does not have any of these options, the prompts will not appear.

Function prompts

Table 3-14 lists all the function prompts in the "Options" Set Up group.

Table 3-14 Options Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
AUX OUT	Auxiliary Output Option	DISABL IN 1 IN 2 PV DEV OUTPUT SP IN 3 PV 2 DEV 2 OUT 2 SP 2	DISABL
4mA VAL	Low Scaling Factor	Low scale value to represent 4 mA.	0.0
20mA VAL	High Scaling Factor	High scale value to represent 20 mA.	100.0
REM SW1	Remote Switching 1 selections	NONE To MAN To SP1 To SP2 To DIR To HOLD ToPID2 PV IN2 PV IN3 To RUN To BGN	NONE
REM SW2	Remote Switching 2 selections	Same as "REM SW1"	NONE

3.18 Communications Set Up Group

Introduction

This data deals with the Communications option that is available with your controller. This option allows the controller to be connected to a host computer via a RS422/485 or DMCS bus.

If your controller does not have this option, the prompts will not appear.

Function prompts

Table 3-15 lists all the function prompts in the "COM" Set Up group.

Table 3-15 Commun Group Function Prompts

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
ComSTATE	Communications Option State	DISABL DMCS RS422/485	DISABL
ComADDR	Communications Station Address (Loop 1) RS422 or DMCS	1 to 31 (DMCS) 1 to 99 (RS422)	3
ComADDR2	Communications Station Address (Loop 2) RS422 or DMCS	1 to 31 (DMCS) 1 to 99 (RS422)	0
SHEDTIME	Shed Time	0 to 255 sample periods 0 = No Shed	30
PARITY (RS422/485 Only)	Parity	ODD EVEN	ODD
BAUD (RS422/485Only)	Baud Rate	300 4800 600 9600 1200 19200 2400	19200

Table 3-15 continued on next page

Function prompts Table 3-15 lists all the function prompts in the "Commun" Set Up group.

Table 3-15 Commun Group Function Prompts, continued

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
SHEDMODE	Shed Controller Mode and Output Level	LAST TO MAN FSAFE TO AUTO	LAST
SHED SP	Shed Setpoint Recall	TO LSP TO CSP	TO LSP
UNITS	Communication Units	PERCNT ENG	PERCNT
CS RATIO	Loop 1 Computer Setpoint Ratio	–20.00 to 20.00	1.00
CS BIAS	Loop 1 Computer Setpoint BIAS	–999.0 to 9999 Engineering Units –999 to 2000% of CSP Span	0.0
CS2 RATIO	Loop 2 Computer Setpoint Ratio	–20.00 to 20.00	1.00
CS2 BIAS	Loop 2 Computer Setpoint BIAS	–999.0 to 9999 Engineering Units –999 to 2000% of CSP Span	0.0
DMCS SW	DMCS Type Selection	ULTRA 5000	5000
LOOPBACK (DMCS Only)	Local Loop Back	DISABL ENABLE	DISABL

3.19 Alarm Parameter Set Up Group

Introduction

This data deals with the Alarms function that is available with your controller.

There are two alarms available. Each alarm has two setpoints.

You can configure each of these two setpoints to alarm on one of several events, and you can configure each setpoint to alarm High or Low.

Function prompts

Table 3-16 lists all the function prompts in the "Alarms" Set Up group.

Table 3-16 Alarms Group Function Prompts

Function Prompt Lower Display	**Function Name**	**Selections or Range of Setting** Upper Display	**Factory Setting**
A1S1 VAL	Alarm 1, Setpoint 1 Value	Within the range of selected parameter or PV Span for Deviation Alarm	90
A1S2 VAL	Alarm 1, Setpoint 2 Value	Within the range of selected parameter or PV Span for Deviation Alarm	10
A2S1 VAL	Alarm 2, Setpoint 1 Value	Within the range of selected parameter or PV Span for Deviation Alarm	95
A2S2 VAL	Alarm 2, Setpoint 2 Value	Within the range of selected parameter or PV Span for Deviation Alarm	5
A1S1 TYPE	Alarm 1, Setpoint 1 Type	NONE IN 1 IN 2 PV (Process Variable) DEV OUTPUT SHED (Communications) EV ON EV OFF IN 3 PV 2 DEV 2 OUT 2	OUTPUT
A1S2 TYPE	Alarm 1, Setpoint 2 Type	Same as A1S1TYPE	OUTPUT

Table 3-16 continued on next page

Function prompts, continued

Table 3-16 lists all the function prompts in the "Alarms" Set Up group.

Table 3-16 Alarms Group Function Prompts, continued

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
A2S1 TYPE	Alarm 2, Setpoint 1 Type	Same as A1S1TYPE	OUTPUT
A2S2 TYPE	Alarm 2, Setpoint 2 Type	Same as A1S1TYPE	OUTPUT
A1S1 H L	Alarm 1, Setpoint 1 State	LOW HIGH	HI
A1S1 E V	Alarm 1, Setpoint 1 Event	BEGIN END	- -
A1S2 H L	Alarm 1, Setpoint 2 State	LOW HIGH	LO
A1S2 E V	Alarm 1, Setpoint 2 Event	BEGIN END	- -
A2S1 H L	Alarm 2, Setpoint 1 State	LOW HIGH	HI
A2S1 E V	Alarm 2, Setpoint 1 Event	BEGIN END	- -
A2S2 H L	Alarm 2, Setpoint 2 State	LOW HIGH	LO
A2S2 E V	Alarm 2, Setpoint 2 Event	BEGIN END	- -
AL HYST	Alarm Hysteresis	0.0 to 5.0 % of Output or Span as appropriate	0.1
ALM ACTN	Alarm Relay Coil Action	RLYoN RLYoFF	RLYoN

3.20 Display Parameters Set Up Group

Introduction

This data deals with the Decimal Place, Units of Temperature, Power Frequency, and Process ID Tag.

Function prompts

Table 3-17 lists all the function prompts in the "DISPLAY" Set Up group.

Table 3-17 Display Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
DECIMAL	Control Loop 1 Decimal Place	XXXX XXX.X XX.XX X.XXX	XXXX
DECIMAL2	Control Loop 2 Decimal Place	XXXX XXX.X XX.XX X.XXX	XXXX
BARGRAPH	Bargraph Representation	DEV OUTPUT DEVOUT	DEV
UNITS	Control Loop 1 Temperature Units	DEG F DEG C NONE	NONE
UNITS 2	Control Loop 2 Temperature Units	DEG F DEG C NONE	NONE
PWR FREQ	Power Frequency	60 Hertz 50 Hertz	60HZ

3.21 Calib Group

Calibration data

The prompts used here are for field calibration purposes.
Refer to *Section 7– Input Calibration* in this manual for complete information and instructions.

3.22 Status Group

Status Test Data

The prompts used here are read only.
They are used to determine the reason for a controller failure.
Refer to *Section 9– Troubleshooting* in this manual for complete information.

3.23 Configuration Record Sheet

Keep a record Enter the value or selection for each prompt on this sheet so you will have a record of how your controller was configured.

Group Prompt	Function Prompt	Value or Selection	Factory Setting
TUNING	PROP BD		- -
	or		
	GAIN		1.0
	RATE MIN		0
	RSET MIN		1.00
	or		
	RSET RPM		- -
	or		
	MAN RSET		0
	PROP BD2		- -
	or		
	GAIN 2		1.0
	RATE2MIN		0
	RSET2MIN		1.00
	or		
	RSET2RPM		- -
	CYCSEC		4
	CYC2SEC		4
	SECURITY		0
	LOCKOUT		CALIB
TUNING2	PROP BD3		- -
	or		
	GAIN3		1.0
	GAIN VALn	Read Only	
	RATE3MIN		0
	RSET3MIN		1.0
	or		
	RSET3RPM		- -
	or		
	MAN3RSET		0
	PROP BD4		- -
	or		
	GAIN 4		1.0
	RATE4MIN		0
	RSET4MIN		1.0
	or		
	RSET4RPM		- -
	CYC3SEC		4
	CYC4SEC		4
SP RAMP	SP RAMP		DISABL
	TIME MIN		3
	FINAL SP		1000
	SP PROG		DISABL
AUTOTUNE	TUNETYPE		A TUNE
	ADAPT		DISABL
	SPCHANGE		DISABL
	KPG		—
	CRITERIA		—
	A TUNE		—
	OUT STEP		20
	AT ERROR	Read Only	

Group Prompt	Function Prompt	Value or Selection	Factory Setting
ALGORITHM	CONT ALG		PID A
	INPUT 2		
	INPUT 3		
	PID LOOPS		1 or 2
	CONT2ALG		PID A
	OUT OVRD		DISABLE
	INP2 ALG		NONE
	ATM PRES		760.0
	PC CO		0.2
	MATH K		1.00
	INP3 ALG		NONE
	PV HI		1000
	PV LO		0
OUT ALG	OUT ALG		URRENT
	4–20 RNG		100 PCT
	OUT ALG2		CURRENT
	RLY STATE		3OFF 4ON
INPUT 1	IN1TYPE		0-10MV
	XMITTER1		LINEAR
	IN1 HI		1000
	IN1 LO		0
	BIAS IN1		0
	FILTER 1		0
	BURNOUT1		NONE
	EMMISSIV1		1.00
NPUT 2	IN2TYPE		0-10MV
	XMITTER2		LINEAR
	IN2 HI		1000
	IN2 LO		0
	RATIO2		1.0
	BIAS UNIT		ENG
	BIAS IN2		0
	FILTER 2		0
	BURNOUT2		NONE
	EMMISSIV2		1.00
INPUT 3	XMITTER3		LINEAR
	IN3 HI		1000
	IN3 LO		0
	RATIO3		1.0
	BIAS IN3		0
	FILTER 3		0

Continued
next page

3.23 Configuration Record Sheet, Continued

Group Prompt	Function Prompt	Value or Selection	Factory Setting
CONTROL	PID SETS		1 ONLY
	SW VALUE		0
	LSP's		1 ONLY
	RSPSRC		NONE
	AT BIAS		DISABLE
	SP TRACK		NONE
	PWR MODE		AM SP
	PWR OUT		F'SAFE
	SP HI LIM		1000
	SP LO LIM		0
	ACTION		REVERS
	OUTHILIM		100.0
	OUTLOLIM		0.0
	I HILIM		100.0
	I LOLIM		0.0
	DROPOFF		0.0
	DEADBAND		1.0
	OUT HYST		0.5
	FAILSAFE		0.0
	PBorGAIN		GAIN
	MINorRPM		MIN
CONTROL2	PV2 SRC		IN 2
	PID SETS		1 ONLY
	SW VALUE		0
	LSP's		1 ONLY
	RSPSRC		NONE
	AT BIAS		DISABL
	SP TRACK		NONE
	SP HILIM		1000
	SP LOLIM		0
	ACTION		REVERS
	OUTHILIM		100.0
	OUTLOLIM		0.0
	I HILIM		100.0
	I LOLIM		0.0
	DROPOFF		0.0
	DEADBAND		1.0
	FAILSAFE		0 or 50
OPTIONS	AUX OUT		OUTPUT
	4mA VAL		0.0
	20mA VAL		100.0
	REM SW1		NONE
	REM SW2		NONE

Group Prompt	Function Prompt	Value or Selection	Factory Setting
COM	COMSTATE		DMCS
	COM ADDR		3
	SHED TIME		30
	PARITY		ODD
	BAUD		19200
	SHEDMODE		LAST
	SHED SP		TO LSP
	UNITS		PERCNT
	CS RATIO		1.00
	CS BIAS		0.0
	CS2RATIO		1.00
	CS2BIAS		0.0
	DMCS SW		5000
	LOOPBACK		DISABLE
ALARMS	A1S1 VAL		90
	A1S2 VAL		10
	A2S1 VAL		95
	A2S2 VAL		5
	A1S1TYPE		OUTPUT
	A1S2TYPE		OUTPUT
	A2S1TYPE		OUTPUT
	A2S2TYPE		OUTPUT
	A1S1 H LEV		HI
	A1S2 H LEV		LO
	A2S1 H LEV		HI
	A2S2 H LEV		LO
	AL HYST		0.1
	ALM ACT		RLY ON
DISPLAY	DECIMAL		XXXX
	DECIMAL2		XXXX
	BARGRAPH		DEV
	UNITS		DEG F
	UNITS2		DEG F
	PWR FREQ		60HZ

Section 4 – Configuration Prompt Definitions

4.1 Overview

Introduction

This section provides information for all the user configurable parameters listed in the *Section 3 - Configuration.* If you aren't familiar with these parameters, this section gives you the parameter prompt, the selection or range of setting that you can make, and a definition of how each parameter setting affects controller performance. It will also refer you to any other prompts that might be affected by your selection.

What's in this section?

The table below lists the topics that are covered in this section. They are listed in the order of their appearance in the controller.

Topic		See Page
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4.2 Tuning Parameters Set Up Group

Introduction

Tuning consists of establishing the appropriate values for the tuning constants for a single loop controller. These parameters are also for Loop 1 of a 2 Loop or Cascade control configuration.
Adaptive Tune/Autotune feature automatically selects Gain, Rate, and Reset.
This section also contains Keyboard Lockout/Security selections.

Set this group last

Because this group contains functions that have to do with security and lockout, we recommend that you configure this group last, after all the other configuration data has been loaded.

Tuning group prompts

Table 4-1 lists all the function prompts in the Tuning setup group and their definitions.

Table 4-1 Tuning Group Prompt Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PROP BD or **GAIN**	0.1 to 9999% or 0.1 to 1000	**PROPORTIONAL BAND** is the percent of the range of the measured variable for which a proportional controller will produce a 100% change in its output. **GAIN** is the ratio of output change (%) over the measured variable change (%) that caused it. $G = \frac{100\%}{PB\%}$ where PB is the proportional band (in %) If the PB is 20%, then the Gain is 5. And, at those settings, a 3% change in the error signal (SP-PV) will result in a 15% change in the controller's output due to proportional action. If the Gain is 2, then the PB is 50%. Defined as "HEAT" Gain on Duplex models for variations of Heat/Cool applications or 3 Position charge time. The selection of Prop. Band or Gain is made in the "CONTROL" parameter group under prompt "PBorGAIN."
RATE MIN	0.08 to 10.00 minutes 0.08 or less = OFF	**RATE** action, in minutes, affects the controller's output whenever the deviation is changing; and affects it more when the deviation is changing faster. Defined as "HEAT" Rate on Duplex models for variations of Heat/Cool applications. Only available with Control Algorithm s: PID-A, PID-B, PD+MR.

Table 4-1 continued on next page

Table 4-1 Tuning Group Prompt Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
RSET MIN or **RSET RPM**	0.02 to 50.00	**RSET MIN** = RESET IN MINUTES / REPEAT **RSET RPM** = RESET IN REPEATS PER MINUTE **RESET** (Integral Time) adjusts the controller's output in accordance with both the size of the deviation (SP-PV) and the time it lasts. The amount of the corrective action depends on the value of Gain. The Reset adjustment is measured as how many times proportional action is repeated/minute or how many minutes before one repeat of the proportional action occurs. Used with control algorithm PID-A or PID-B. Defined as "HEAT" Reset on Duplex models for variations of Heat/Cool applications. Not available with control algorithm “PD + MR” The selection of minutes per repeat or repeats per minute is made in the “CONTROL” parameters group under prompt "MINorRPM."
MAN RSET	–100 to +100 (in % output)	**MANUAL RESET** is only applicable if you use control algorithm PD WITH MANUAL RESET. Because a proportional controller will not necessarily line out at setpoint, there will be a deviation (offset) from setpoint. This eliminates the offset and lets the PV line out at setpoint.
PROP BD2 or **GAIN 2**	0.1 to 999.9% or 0.1 to 1000	**PROPORTIONAL BAND 2** or **GAIN 2**, **RATE 2**, and **RESET 2** parameters are the same as previously described for “Heat” except that they refer to the **cool** zone tuning constants on duplex models or the second set of PID constants, whichever is pertinent.
RATE2MIN	0.08 to 10.00 minutes 0.08 or less = OFF	
RSET2MIN **RSET2RPM**	0.02 to 50.00	
CYC SEC	1 to 120 seconds	**CYCLE TIME (HEAT)** determines the length of one time proportional output relay cycle. Defined as "HEAT" cycle time for Heat/Cool applications.
CYC2 SEC	1 to 120 seconds	**CYCLE TIME 2 (COOL)** is the same as above except it applies to Duplex models as the cycle time in the "COOL" zone of Heat/Cool applications or for 2nd set of PID constants.

Table 4-1 continued on next page

Table 4-1 Tuning Group Prompt Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
SECURITY	0001-4095	**SECURITY CODE** – The level of keyboard lockout may be changed in the set up mode. Knowledge of a security code may be required to change from one level to another. Select this number here, copy it, and keep it in a secure location. Entering "0" disables the security code feature. NOTE: The Security Code is for keyboard entry only and is not available via communications. Can only be changed if "LOCKOUT" selection is "NONE".
LOCKOUT		**LOCKOUT** applies to one of the functional groups: Configuration, Calibration, Tuning, Adaptive Tune. **DO NOT CONFIGURE UNTIL ALL CONFIGURATION IS COMPLETE.**
	NONE	No Lockout – all groups read/write.
	CALIB	**CALIB** – All are available for read/write except for the Calibration.
	+CONF	**+CONF** – Tuning, SP Ramp, and Adaptive Tune groups are read/write. All other groups are read only. Calibration group is not available.
	+VIEW	**+VIEW** – Tuning and Setpoint Ramp parameters are read/write. No other parameters are viewable.
	MAX	**MAX** – Tuning and Setpoint Ramp parameters are available for read only. No other parameters are viewable.

4.3 Tuning Loop 2 Parameters Set Up Group

Introduction

Tuning L2 (Loop 2) consists of establishing the appropriate values for the tuning constants for Loop 2 on 2 Loops or Internal Cascade control.

Tuning group prompts

Table 4-2 lists all the function prompts in the Tuning L2 setup group and their definitions.

Table 4-2 Tuning L2 (Loop 2) Group Prompt Definitions

<table>
<tr><th>Lower Display Prompt</th><th>Upper Display Range of Setting or Selection</th><th>Parameter Definition</th></tr>
<tr><td>PROP BAND3
GAIN 3
RATE3MIN
RESET3MIN or
RESET3RPM
MAN3RESET
PROP BAND4
GAIN 4
RATE4MIN
RESET4MIN or
RESET4RPM
CYC3SEC
CYC4SEC</td><td>Same as "TUNING"</td><td>The definitions listed for the parameters at the left are the same as those listed previously for the TUNING parameters Set Up Group except they are for Loop 2.
The table below shows you how to use them for Duplex Heat/Cool applications.
DUPLEX OUTPUT RANGES
0 TO 50%-TUNING SETS 2 AND 4:COOL
50 TO 100%-TUNING SETS 1 AND 3: HEAT
<table>
<tr><th>Duplex Output Range</th><th>Heat or Cool</th><th>Loop 1</th><th>Loop 2</th></tr>
<tr><td>0 to 50%</td><td>Cool</td><td>PID SET 2
Gain 2
Rate 2
Reset 2
Cycle 2</td><td>PID SET 4
Gain 4
Rate 4
Reset 4
Cycle 4</td></tr>
<tr><td>50 to 100%</td><td>Heat</td><td>PID SET 1
Gain
Rate
Reset
Cycle</td><td>PID SET 3
Gain 3
Rate 3
Reset 3
Cycle 3</td></tr>
</table>
</td></tr>
</table>

4.4 Setpoint Ramp/Program Set Up Group

Single Setpoint Ramp

This data deals with enabling Single Setpoint Ramp function on one or both control loops. You can start or stop the ramp by pressing the RUN/HOLD key .
A single setpoint ramp can be configured to occur between the current local setpoint and a final local setpoint over a time interval of from 1 to 255 minutes.

Setpoint Program

The Setpoint Ramp/Program Set Up group also contains a function parameters that lets you configure a specific Ramp/Soak Program. SP RAMP must be disabled to allow SP PROG. *See Section 6 - Setpoint Ramp/Soak Programming for details.*

Setpoint Ramp/ Program group prompts

Table 4-3 lists all the function prompts in the Setpoint Ramp/Program setup group and their definitions.

Table 4-3 Setpoint Ramp/Rate Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
SP RAMP		**SINGLE SETPOINT RAMP** — make a selection to enable or disable the setpoint ramp function. Make sure you configure a ramp time and a final setpoint value.
	DISABL	**DISABLE SETPOINT RAMP** — Disables the setpoint ramp option
	ENABLE	**ENABLE SETPOINT RAMP** — Allows the single setpoint ramp prompts for Loop 1 to be shown.
	ENABLE 2	**ENABLE SETPOINT RAMP** — Allows the single setpoint ramp to run on Loop 2.
	ENABLE 12	**ENABLE SETPOINT RAMP** — Allows the single setpoint ramp to be run on Loop 1 and Loop 2.
TIME MIN	0 to 255 minutes	**SETPOINT RAMP TIME** — The time it takes to go from start to final setpoint. Enter the number of minutes desired to reach the final setpoint. A ramp time of "0" implies and immediate change of setpoint.

Table 4-3 continued on next page

Setpoint Ramp/ Program group prompts, continued

Table 4-3 Setpoint Ramp/Rate Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
FINAL SP	Within SP limits	**SETPOINT RAMP FINAL SETPOINT** — Enter the value desired for the final setpoint. The controller will operate at the setpoint set here when ramp is ended. **ATTENTION** If the ramp is on "HOLD", the held setpoint can be changed by the ▲ ▼ keys. However, the ramp time remaining and original ramp rate is not changed. Therefore, when returning to RUN mode, the setpoint will ramp at the same rate as previous to the local setpoint change and will stop if the final setpoint is reached before the time expires. If the time expires before the final setpoint is reached, it will jump to the final setpoint. **ATTENTION** SP RAMP will cause the SP portion of Adaptive Tune to abort. PV Tune will continue to function normally.
SP PROG (option)		**SETPOINT RAMP/SOAK PROGRAM** Available only with controllers that contain this option. For reasons of convenience, the information for the prompts when SP PROG is enabled are included in *Section 6 — Setpoint Programming Option.* "SP RAMP" must be disabled.
	DISABL	**DISABL -** Must select disable to use the SP Ramp option.
	ENABLE	**ENABLE** - allows the prompts for Setpoint Programming
	ENABLE 2	**ENABLE 2** - allows the Setpoint Program to run on Loop 2
	ENABLE 12	**ENABL 12** - allows the Setpoint Program to be run on Loop and Loop 2

4.5 Adaptive Tune/ Autotune Set Up Group

Adaptive Tune

Adaptive Tune continuously adjusts the PID parameters in response to process variable disturbances and/or setpoint changes. Also, it can be used during start-up without prior initialization or process knowledge.

Autotune

Autotune automatically calculates Gain, Rate, and Reset time (PID) tuning constants for one or both control loops. When initiated on demand, the Autotune algorithm measures a process step and automatically generates the PID tuning constants needed for no overshoot on your process.

Adaptive Tune /Autotune group prompts

Table 4-4 lists all the function prompts in the "AUTOTUNE" setup group and their definitions.

Table 4-4 Autotune Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
TUNE TYPE (Option)		**TUNING TYPE SELECTION**
	ADAPT	**ADAPTIVE TUNING** - See ADAPT
	A TUNE	**AUTOTUNE** - See A TUNE
ADAPT		**ADAPTIVE TUNE**
	DISABL	**DISABLE ADAPTIVE TUNE** – Disables the Adaptive Tune function.
	SPoNLY	**SETPOINT ONLY** – This selection tunes on setpoint changes only. It employs time domain analysis to accelerate line out at any desired setpoint without prior initialization or process knowledge. SP Only is the recommended start-up mode - to be used when no knowledge of the process tuning values is available. In the Start-up mode, and after enabling ADAPTIVE, the operator simply lines out the process variable in manual mode, selects the desired SP value and switches to automatic mode.
	SP + PV	**SETPOINT PLUS PROCESS VARIABLE** - This selection tunes on setpoint changes but also whenever a PV disturbance of 0.3% span or larger occurs on Loop 1. It will take 1 and 1/2 process cycles around setpoint before any process recognition and re-tuning can occur due to PV disturbances.
SP CHANG	5 to 15%	**SETPOINT CHANGE -** The minimum setpoint change that will result in re-tuning must be configured between 5% and 15%: i.e. If the range is 0 to 2400 and 5% is configured, re-tuning will occur if the setpoint change is 120 or larger. If the setpoint change is less than 5 or greater than 15, a "T" will still appear and a change in Gain may be necessary.

Table 4-4 continued on next page

Table 4-4 Autotune Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
KPG	0.10 to 10.00	**PROCESS GAIN** – This is the Gain of the process being tuned on Loop 1. It is automatically calculated during tuning process. This is normally a READ only value. It should only need to be changed if the controller fails to identify the process. In this case, set the value to the algebraic value of PV in percent, divided by output in percent while in the manual mode. ATTENTION Note you must disable Adaptive tune to change tuning constant values from the keyboard.
CRITERIA	 NORMAL FAST	TUNING CRITERIA - Selecta criteria best suited for your process on Loop 1. NORMAL - Orginal critical damping FAST - a more aggressive tuning with a minimalpossible overshoot of less than 0.5%. For exampl: Slightly underdamped.
ADAPTIVE 2		**ADAPTIVE TUNE - Loop 2**
	DISABL	**DISABLE ADAPTIVE TUNE** – Disables the Adaptive Tune function for Loop 2.
	SPoNLY	**SETPOINT ONLY** – This selection tunes on setpoint changes only on Loop 2. It employs time domain analysis to accelerate line out at any desired setpoint without prior initialization or process knowledge. SP Only is the recommended start-up mode - to be used when no knowledge of the process tuning values is available. In the Start-up mode, and after enabling ADAPTIVE, the operator simply lines out the process variable in manual mode, selects the desired SP value and switches to automatic mode.
	SP + PV	**SETPOINT PLUS PROCESS VARIABLE** - This selection tunes on setpoint changes but also whenever a PV disturbance of 0.3% span or larger occurs on Loop 2. It will take 1 and 1/2 process cycles around setpoint before any process recognition and re-tuning can occur due to PV disturbances.
SP CHANG2	.5 to 15%	**SETPOINT CHANGE LOOP 2-** The minimum setpoint change on Loop 2 that will result in re-tuning must be configured between 5% and 15%:
KPG2	0.10 to 10.00	**PROCESS GAIN LOOP 2** – This is the Gain of the process being tuned on Loop 2. It is automatically calculated during tuning process. This is normally a READ only value. It should only need to be changed if the controller fails to identify the process. In this case, set the value to the algebraic value of PV in percent, divided by output in percent while in the manual mode. ATTENTION Note you must disable Adaptive tune to change tuning constant values from the keyboard.

Continued on next page

Table 4-4 Autotune Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
CRITERA2	NORMAL FAST	TUNING CRITERIA - Selecta criteria best suited for your process on Loop 2. NORMAL - Orginal critical damping FAST - a more aggressive tuning with a minimalpossible overshoot of less than 0.5%. For exampl: Slightly underdamped.
A TUNE		**AUTOTUNE FUNCTION**
	DISABL	**DISABL** - Disables Autotune Function
	A STEP	**A STEP(Loop 1)** - Automatic steps let you perform an Autotune with a step size automatically generated. The controller can be previously operating in automatic mode.
	M STEP	**M STEP(Loop 1)** - Manual step lets you choose an output step size, in percent, that will be large enough to result in a PV change. The value of the output step size is selected under function prompt "OUT STEP". The controller must be in Manual Mode to initiate Autotune (M Step).
	A STEP2	**A STEP(Loop 2)** - Automatic steps let you perform an Autotune on Loop 2 with a step size automatically generated. The controller can be previously operating in automatic mode.
	M STEP2	**M STEP(Loop 2)** - Manual step lets you choose an output step size, in percent, that will be large enough to result in a PV change on Loop 2. The value of the output step size is selected under function prompt "OUT STEP". The controller must be in Manual Mode to initiate Autotune (M Step).
OUT STEP	−100 to +100% of output in 1% increments	**OUTPUT STEP SIZE** - Choose an output step size, in percent, that will be applied to the output of the controller when Autotune is initiated. This step must be large enough to result in a process variable (PV) change of at least 2.5% of span. This step can be predetermined by stroking the process in manual mode.
AT ERROR		**ADAPTIVE TUNE ERROR STATUS** – When an error is detected in the Adaptive Tune process, an error prompt will appear. **See *Section 5 -Operation* for a list of error prompts.**

4.6 Algorithm Data Set Up Group

Introduction

This data deals with various algorithms in the controller:

- Control algorithm,
- Input algorithm,
- Enable the second or third input
- Selecting the Number of PID Loops, and
- Control Algorithm for loop 2
- Output Override.

Algorithm group prompts

Table 4-5 lists all the function prompts in the Algorithm setup group and their definitions.

Table 4-5 Algorithm Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
CONT ALG		The **CONTROL ALGORITHM** lets you select the type of control that is best for your process.
	ON-OFF	**ON/OFF** is the simplest control type. The output can be either ON (100%) or OFF (0%). The Process Variable (PV) is compared with the setpoint (SP) to determine the sign of the error (ERROR = PV-SP). The ON/OFF algorithm operates on the sign of the error signal. In Direct Acting Control, when the error signal is positive, the output is 100%; and when the error signal is negative, the output is 0%. If the control action is reverse, the opposite is true. An adjustable overlap (Hysteresis Band) is provided between the on and off states. Other prompts affected: "OUT HYST" **DUPLEX ON/OFF** is an extension of this algorithm when the output is configured for Duplex. It allows the operation of a second ON/OFF output. There is a deadband between the operating ranges of the two inputs and an adjustable overlap (hysteresis) of the on and off states of each output. Both Deadband and Hysteresis are separately adjustable. With no relay action the controller will read 50%. Other prompts affected: "OUT HYST" and "DEADBAND"

Table 4-5 continued on next page

Table 4-5 Algorithm Group Definitions, continued

Lower Display Prompt	**Upper Display Range of Setting or Selection**	**Parameter Definition**
CONT ALG continued	PID A NOTE: PID A should not be used for Proportional only action. i.e. no integral (reset) action. Instead, use PD+MR with rate set to 0.	**PID A** is normally used for three-mode control. This means that the output can be adjusted somewhere between 100% and 0%. It applies to all three control actions — Proportional (P), Integral (I), and Derivative (D) — to the error signal. Proportional (Gain) — regulates the controller's output in proportion to the error signal (the difference between Process Variable and Setpoint). Integral (Reset) -- regulates the controller's output to the size of the error and the time the error has existed. (The amount of corrective action depends on the value of proportional Gain.) Derivative (Rate) -- regulates the controller's output in proportion to the rate of change of the error. (The amount of corrective action depends on the value of proportional Gain.)
	PID B	**PID B** Unlike the PID-A equation, the controller gives only an integral response to a setpoint change, with no effect on the output due to the gain or rate action, and it gives full response to PV changes. Otherwise controller action is as described for the PID-A equation. See note on PID-A.
	PD+MR	**PD WITH MANUAL RESET** is used whenever integral action is not wanted for automatic control. The equation is computed with no integral contribution. The MANUAL RESET, which is operator adjustable, is then added to the present output to form the controller output. Switching between manual and automatic mode will not be bumpless. If you select PD with Manual Reset you can also configure the following variations • PD (Two Mode) control, • P (Single Mode) control. Set Rate(D) and/or Reset Time(I) to 0. Other prompts affected: "MAN RSET"
	3PSTEP	**THREE POSITION STEP** - algorithm is an extension of the ON/OFF Duplex control and includes internal feedback of the state of the relays. The effect of this control action is that the ON and OFF time of the output relay change in proportion to the error signal and the Gain and reset time settings.

Table 4-5 continued on next page

Table 4-5 Algorithm Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
INPUT 2	ENABLE DISABLE	**INPUT 2** algorithm allows you to enable or disable the second input. Appears only when input 2 is ordered.
INPUT 3	ENABLE DISABLE	**INPUT 3** algorithm allows you to enable or disable the second input. Appears only when input 3 is ordered.
PID LOOPS		**PID LOOPS** - This is the PID loop selection.
	1 LOOP	**1 LOOP** - select to use one loop of control.
	2LOOPS	**2LOOPS** - Select to use two PID loops of control, each with two sets of tuning parameters and a set of control parameters.
	CASCADE	**CASCADE** - Select for Cascade Control. Cascade control is a control system where the output of one PID loop is used to adjust the setpoint of the second control loop and the second loop's output actually adjusts the final control element.
CONT2 ALG		The **CONTROL 2 ALGORITHM** lets you select the type of control for Loop 2 that is best for your process.
	PID A NOTE: PID A should not be used for Proportional only action. i.e. no integral (reset) action. Instead, use PD+MR with rate set to 0.	**PID A** is normally used for three-mode control. This means that the output can be adjusted somewhere between 100% and 0%. It applies to all three control actions — Proportional (P), Integral (I), and Derivative (D) — to the error signal. Proportional (Gain) — regulates the controller's output in proportion to the error signal (the difference between Process Variable and Setpoint). Integral (Reset) -- regulates the controller's output to the size of the error and the time the error has existed. (The amount of corrective action depends on the value of proportional Gain.) Derivative (Rate) -- regulates the controller's output in proportion to the rate of change of the error. (The amount of corrective action depends on the value of proportional Gain.)
	PID B	**PID B** Unlike the PID-A equation, the controller gives only an integral response to a setpoint change, with no effect on the output due to the gain or rate action, and it gives full response to PV changes. Otherwise controller action is as described for the PID-A equation. See note on PID-A.

Table 4-5 continued on next page

4.6 Algorithm Data Set Up Group, Continued

Table 4-5 Algorithm Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
CONT2 ALG, continued	PD+MR	**PD WITH MANUAL RESET** is used whenever integral action is not wanted for automatic control. The equation is computed with no integral contribution. The MANUAL RESET, which is operator adjustable, is then added to the present output to form the controller output. Switching between manual and automatic mode will not be bumpless. If you select PD with Manual Reset you can also configure the following variations • PD (Two Mode) control, • P (Single Mode) control. Set Rate(D) and/or Reset Time(I) to 0. Other prompts affected: "MAN 3RSET"
OUTOVRD		**OUTPUT OVERRIDE SELECT** - This selection lets you select high or low output override.
	DISABL	**DISABLE**s Output Override
	HI SEL	**HIGH SELECT** - The controller will select the higher of output 1 or output 2 and direct it to output 1 rear terminals.
	LO SEL	**LOW SELECT** - The controller will select the lower of output 1 or output 2 and direct it to output 1 rear terminals. **ATTENTION** The unselected output will track the selected output within 5% to eliminate windup in the unselected direction.
INP2 ALG (not displayed when input 2 is disabled)		**INPUT 2 ALGORITHM** lets you select the algorithm to be applied to input 2. NOTE: All input 2 algorithms operate in Engineering Units except for feed forward which operates in percent of range units.
	NONE	**NONE** - No Input 2 algorithm configured
	W AVG	**WEIGHTED AVERAGE** - When you configure for Weighted Average, the controller will combine the two inputs and compute a PV for the control algorithm from the following equation: $PV = \frac{\text{Input 1} + (K \times \text{Input 2})}{(1 + K)}$ Both Inputs must have the same range in engineering units.

Table 4-5 continued on next page

Table 4-5 Algorithm Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
INP2ALG continued	REL HUM	**RELATIVE HUMIDITY -** Input 1 reads the wet bulb temperature. Input 2 reads the dry bulb temperature. Both inputs must be 100 ohm RTD inputs. The controller will indicate measured Relative Humidity as a Process Variable PV) with a setpoint range of 0 to 100% RH.
	FFWRD	**FEEDFORWARD** - Feedforward uses Input 2, following a Ratio and Bias calculation as a value summed directly with the PID computed output value and sent, as an output value, to the final control element. Applies to Loop 1 only. This algorithm will only function in automatic mode. The following formula applies: Controller Output= PID Output + (Input2 x Ratio + Bias)
	ADDER	**ADDER WITHOUT RATIO AND BIAS -** The following formula applies: PV = (Input 1 + Bias) + Input 2
	SUBTRC	**SUBTRACTOR WITHOUT RATIO AND BIAS -** The following formula applies: PV = (Input 1 + Bias) – Input 2
	SUMW RB	**SUMMER WITH RATIO AND BIAS-** The following formula applies: In1(EU) + [In2(EU) times R plus Bias] PV = (Input 1 + Bias) + (Input 2 x Ratio + Bias)
	HI SEL	**INPUT HIGH SELECT WITHOUT RATIO AND BIAS -** This selection specifies the PV as the higher of Input 1 or Input 2. The following formula applies: PV = Higher of (Input 1 + Bias) or Input 2
	LO SEL	**INPUT LOW SELECT WITHOUT RATIO AND BIAS -** This selection specifies the PV as the lower of Input 1 or Input 2. The following formula applies: PV = Lower of (Input 1 + Bias) or Input 2
	HI SEL +	**INPUT HIGH SELECT PLUS RATIO AND BIAS -** This selection specifies the PV as the higher of Input 1 or Input 2. The following formula applies: PV = Higher of (Input 1 + Bias) or (Input 2 x Ratio + Bias)
	LO SEL +	**INPUT LOW SELECT PLUS RATIO AND BIAS -** This selection specifies the PV as the lower of Input 1 or Input 2. The following formula applies: PV = Lower of (Input 1 + Bias) or (Input 2 x Ratio + Bias)

Table 4-5 continued on next page

Table 4-5 Algorithm Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
INP2ALG continued	√ MUL DIV (note 1)	**MULTIPLIER DIVIDER WITH SQUARE ROOT** - The following formula applies: $PV = K \times \sqrt{\frac{(\text{Input 1} + \text{Bias}) \times (\text{Input 3} \times \text{Ratio} + \text{Bias})}{(\text{Input 2} \times \text{Ratio} + \text{Bias})}} \; X (PV_{HI} - PV_{LO})$
	√ MULTIPLY	**MULTIPLIER WITH SQUARE ROOT** - The following formula applies: $PV = K \times \sqrt{(\text{Input 1} + \text{Bias}) \times (\text{Input 2} \times \text{Ratio} + \text{Bias}) \times (\text{Input 3} \times \text{Ratio} + \text{Bias})} \; X (PV_{HI} - PV_{LO})$
	MULT DIV	**MULTIPLIER DIVIDER** - The following formula applies: $PV = K \times \frac{(\text{Input 1} + \text{Bias}) \times (\text{Input 3} \times \text{Ratio} + \text{Bias})}{(\text{Input 2} \times \text{Ratio} + \text{Bias})} \; X (PV_{HI} - PV_{LO})$
	MULTIPLY	**MULTIPLIER** - The following formula applies: $PV = K \times (\text{Input 1} + \text{Bias}) \times (\text{Input 2} \times \text{Ratio} + \text{Bias}) \times (\text{Input 3} \times \text{Ratio} + \text{Bias}) \; X (PV_{HI} - PV_{LO})$
	Where: K = 0.001 to 1000 (configurable) PV Hi and PV Lo are configurable over a range of –999 to 9999	
	FFWRD 2	**FEEDFORWARD FOR LOOP 2** - This algorithm uses input 2, following a Ratio and Bias calculation as a value summed directly with the PID computer value and sent, as an output value, to the final control element. This algorithm can only be used in automatic mode.
	CARB A	**CARBON POTENTIAL A -** Make this selection if you have a Cambridge or Marathon monitor type Zirconium Oxide sensor as a second input.
	CARB B	**CARBON POTENTIAL B -** Make this selection if you have a Corning type Zirconium Oxide sensor as Input 2. This algorithm requires a temperature range for Input 1 within the region of 1400 to 2000°F.
	CARB C	**CARBON POTENTIAL C -** Make this selection if you have an A.A.C.C. type Zirconium Oxide sensor as Input 2. This algorithm requires a temperature range for Input 1 within the region of 1400 to 2000°F.
	CARB D	**CARBON POTENTIAL D-** Make this selection if you have a Barber Coleman, MacDhui, or Bricesco type Zirconium Oxide sensor as Input 2. This algorithm requires a temperature range for Input 1 within the region of 1400 to 2000°F.

Table 4-5 continued on next page

Table 4-5 Algorithm Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
INP2ALG continued	FCC	**CARBON POTENTIAL FCC -** Make this selection if you have a Furnace Controls Corp Accucarb type Zirconium Oxide sensor as Input 2. This algorithm requires a temperature range for Input 1 within the region of 1400 to 2000°F.
	OXYGEN	**INPUT 2 ALGORITHM** lets you select the algorithm to be applied to input 2.: **PERCENT OXYGEN RANGE -** Make this selection if you are using a Zirconium Oxide Oxygen Probe as a second input to measure Percent of Oxygen in a range of 0 to 40 % O_2. This algorithm requires a temperature range for Input 1 within the region of 800 to 3000°F.
	DEWPOINT	**DEWPOINT OF CARBONIZING ATMOSPHERE -** Use this selection if you are using any Zirconium Oxide Carbon Probe as a second input and you want to measure the atmosphere in terms of Dewpoint. The range is –50 to 100°F or –48 to 38°C. This algorithm requires a temperature range for Input 1 within the region of 1000 to 2200°F.
	ATM PRESS	**ATMOSPHERIC PRESSURE COMPENSATION -** is only applicable for Input 2 algorithm "REL HUM" (Relative Humidity). Enter the value of the atmospheric pressure of the process.
	PCT CO	**PERCENT CARBON -** Only applicable for Input 2 Carbon Potential algorithms. Enter the value in percent carbon monoxide that is applicable for the enriching gas used in fractional form. For example: Natural Gas = 20.0% CO, then make the setting 0.200 Propane Gas = 23.0% CO, then make the setting 0.230

Table 4-5 continued on next page

Table 4-5 Algorithm Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
INP2ALG continued		**INPUT 2 ALGORITHM** lets you select the algorithm to be applied to input 2.:
	MATH K	**K CONSTANT FOR WEIGHTED AVERAGE OR MATH SELECTIONS -** Only applicable for Input 2 algorithms "W AVG", or Math selections "√ MULT", √ MULT DIV, "MU DIV", or MULT. When **weighted average** input is configured, the controller will combine the two inputs and compute a PV for the control algorithm from the following equation: $PV = \frac{\text{Input 1} + (K \times \text{Input 2})}{(1 + K)}$ K Range = 0.001 to 1000 When a **math selection** is configured, the controller will make a calculation resulting in a derived PV. See previous pages for formulas. √ MU DIV √ MULT MU DIV MULT The K value is a configurable constant which is used (along with configurable PV_{Hi} and PV_{Lo} values) to enable the Math Equation to calculate the proper numerical value in engineering units. Its value is configurable from 0.001 to 9.999 Input 3 applies when enabled and not configured for Feedforward or Remote Setpoint, otherwise the value is entered at 1.0 and does not influence the calculation.
	PCT H_2	**PERCENT HYDROGEN** - Only applicable for Input 2 algorithm. Enter the value of percent Hydrogen that is applicable. Range = 1 to 99 (%H_2)

Continued on next page

Table 4-5 Algorithm Group Definitions, continued

Lower Display Prompt	**Upper Display Range of Setting or Selection**	**Parameter Definition**
INP3 ALG		**INPUT 3 ALGORITHM** lets you select the algorithm to be applied to input 3. All third input algorithms operate in Engineering units except Feedforward which operates in percent of range.
	FFWRD	**FEEDFORWARD** - Feedforward uses Input 3, following a Ratio and Bias calculation as a value summed directly with the PID computed output value and sent, as an output value, to the final control element. Applies to Loop 1 only. This algorithm will only function in automatic mode. The following formula applies: Controller Output= PID Output + (Input3 x Ratio + Bias)
	SUMW RB	**SUMMER WITH RATIO AND BIAS-** The following formula applies: PV = (Input 1 + IN1Bias) + (Input 3 x IN3Ratio + IN3Bias)
	HI SEL +	**INPUT HIGH SELECT PLUS RATIO AND BIAS -** This selection specifies the PV as the higher of Input 1 or Input 3. The following formula applies: PV = Higher of (Input 1 + Bias) or (Input 3 x Ratio + Bias)
	LO SEL +	**INPUT LOW SELECT PLUS RATIO AND BIAS -** This selection specifies the PV as the lower of Input 1 or Input 3. The following formula applies: PV = Lower of (Input 1 + Bias) or (Input 3 x Ratio + Bias)
	FFWRD 2	**FEEDFORWARD FOR LOOP 2** - This algorithm uses input 3, following a Ratio and Bias calculation as a value summed directly with the PID computer value and sent, as an output value, to the final control element. This algorithm can only be used in automatic mode.
PV HI	–999 to 9999	**PROCESS VARIABLE HIGH RANGE FOR SECOND OR THIRD INPUT ALGORITHM -** Only applicable for Input 2 and 3 algorithms “SUMMER”, “SUBTRACTOR”, “INPUT HI/LO” or one of the general math functions.
PV LO	–999 to 9999	**PROCESS VARIABLE LOW RANGE FOR SECOND OR THIRD INPUT ALGORITHM -** Only applicable for Input 2 and 3 algorithms “SUMMER”, “SUBTRACTOR”, “INPUT HI/LO” or one of the general math functions.

4.7 Output Algorithm Parameters Set Up Group

Introduction

This data deals with various output types in the controller, the Relay State, and the Current Duplex functionality.

Algorithm group prompts

Table 4-6 lists all the function prompts in the "Output Algorithm" setup group and their definitions.

Table 4-6 Output Algorithm Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
OUT ALG		The **OUTPUT ALGORITHM** lets you select the type of output you want.
	TIME	**RELAY SIMPLEX** — This Output algorithm uses one SPDT relay for Time Proportional Control. Its normally open (NO) or normally closed (NC) contacts are selected by positioning an internal jumper. See Section 2 - Installation. Other prompts affected: "OUT HYST".
	CURRNT	**CURRENT SIMPLEX** — Type of output using one 4 to 20 mA signal that can be fed into a positive or negative grounded load of 0 to 1000 ohms. The signal can be re-calibrated for any desired range from 4 to 20 mA for 0 to 100% output.
	POSITN	**POSITION PROPORTIONAL SIMPLEX -** This type of output uses two SPDT relays and a motor which has a 100 to 1000 ohm feedback slidewire. Other prompts affected: "DEADBAND"
	TIME D	**TIME DUPLEX** — This Output algorithm uses two SPDT relays for Time Duplex Proportional Control. Its normally open (NO) or normally closed (NC) contacts are selected by positioning an internal jumper. See Section 2 - Installation. Other prompts affected: "OUT HYST" & "DEADBAND".
	CUR D	**CURRENT DUPLEX** is similar to current simplex but uses a second current output. The second output is usually scaled so that zero and span correspond with 0% and 50% output (cool zone). When the output is 0 to 50%, the controller uses tuning parameter set #2, when the output is 50 to 100% it uses set #1. Other prompts affected: "4-20 RNG" Auxiliary Output must be configured for "OUTPUT".
	CUR TI	**CURRENT/TIME DUPLEX (RELAY = HEAT)** is a variation of duplex with current active for 0 to 50% output (tuning set 2) and Time is active 50 to 100% output (tuning set 1). Other prompts affected: "4-20 RNG", "OUT HYST", and "DEADBAND"
	TI CUR	**TIME CURRENT DUPLEX (RELAY3= COOL)** is similar to "CUR-TI" except that current is active for 50 to 100% and Time is active for 0 to 50%. Other prompts: "4-20 RNG", "OUT HYST", and "DEADBAND"

Table 4-6 continued on next page

Table 4-6 Output Algorithm Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
4-20 RNG		**CURRENT DUPLEX RANGE ALGORITHM** — Used with Output Algorithm selections "CUR-D," "CUR-TI", or "TI-CUR."
	50 PCT	**CURRENT DUPLEX RANGE (SPLIT)** For "CUR D" this enables the normal control current output to provide its full 4–20mA range for 50% to 100% Output change. This current duplex requires that the Auxiliary output provides cool control which is normally configured to provide 4–20mA over 0–50% of output. To enable this, "OUTPUT " must be selected for Auxiliary Output.
	100PCT	**CURRENT DUPLEX RANGE (FULL)** enables the normal control current output to provide duplex control over 0 - 100% of the controller output by providing cool control over 4–12 mA and Heat control over 12–20 mA. Auxiliary output is not required for this type of duplex operation.
OUTALG 2		The **OUTPUT ALGORITHM** lets you select the type of output you want for the **second** control loop See "OUTALG" for definitions.
	NONE TIME CURRNT CUR TI TIME CUR CUR D	**NONE** - No selection **See OUT ALG for definitions** **ATTENTION** Relay Duplex, Position Proportional, and Current/Aux duplex are not allowed on the second control loop.
RLY STATE		**DIGITAL OUTPUT STATUS AT 0% OUTPUT -** allows the following selections:
	1OF 2OF	1OF 2OF Relay 1 de-energized Relay 2 de-energized
	1ON 2ON	1ON 2OF Relay 1 energized Relay 2 de-energized
	1OF 2ON	1OF 2ON Relay 1 de-energized Relay 2 energized
	1ON 2OF	1ON 2ON Relay 1 energized Relay 2 energized
		ATTENTION For units not configured for Time Duplex or Position Proportional, Relay 2 is always de-energized.

4.8 Input 1 Parameters Set Up Group

Introduction

These are the parameters required for Inputs 1: actuation, transmitter characterization, high and low range values in engineering units, Bias, Filter, and Burnout.

Input 1 group prompts

Table 4-7 lists all the function prompts in the Input 1 setup group and their definitions.

Table 4-7 Input 1 Group definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
IN1 TYPE		**INPUT 1 ACTUATION TYPE** -- This selection determines what actuation you are going to use for input one.
	B TC	B thermocouple 105 to 3300°F 41 to 1816°C
	E TC H	E thermocouple high −454 to 1832°F −270 to 1000°C
	E TC L	E thermocouple low −200 to 1100°F −129 to 593°C
	J TC H	J thermocouple high 0 to 1600°F −18 to 871°C
	J TC L	J thermocouple low 20 to 770°F −7 to 410°C
	K TC H	K thermocouple high 0 to 2400°F −18 to 1316°C
	K TC L	K thermocouple low −20 to 1000°F −29 to 538°C
	NNM H	NiNiMo thermocouple high 32 to 2500°F 0 to 1371°C
	NNM L	NiNiMo thermocouple low 32 to 1260°F 0 to 682°C
	NIC TC	Nicrosil-Nisil thermocouple 0 to 2372°F −17.8 to 1300°C
	R TC	R thermocouple 0 to 3100°F −18 to 1704°C
	S TC	S thermocouple 0 to 3100°F −18 to 1704°C
	T TC H	T thermocouple high −300 to 700°F −184 to 371°C
	T TC L	T thermocouple low −200 to 600°F −129 to 316°C
	W TC H	W5W26 thermocouple high 0 to 4200°F −18 to 2316°C
	W TC L	W5W26 thermocouple low 0 to 2240°F −18 to 1227°C
	100 PT	100 Ohm–RTD −300 to 900°F −184 to 482°C
	100 LO	100 Ohm - RTD 0 to 300°F −18 to 149°C
	200PT	200 Ohm - RTD −300 to 900° F −184 to 482°C
	500 PT	500 Ohm–RTD −300 to 900°F −184 to 482C
	RADIAM	Radiamatic (RH) 1400 to 3400°F 760 to 1871°C
	4-20mA	4 to 20 Milliamps
	10M	0 to 10 Millivolts
	10-50M	10 to 50 Millivolts
	0-5	0 to 5 Volts
	1-5 V	1 to 5 Volts
	0-10 V	0 to 10 Volts

Table 4-7 continued on next page

Table 4-7 Input 1Group definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
XMITTER1	B TC E TC H E TC L J TC H J TC L K TC H K TC L NNM H NNM L NIC TC R TC S TC T TC H T TC L W TC H W TC L 100 PT 500 PT 100 LO 200PT LINEAR SQROOT	**TRANSMITTER CHARACTERIZATION** — This selection lets you instruct the controller to characterize a linear input to represent a non-linear one. NOTE: Prompt only appears when a linear actuation is selected at prompt 'IN1 TYPE". FOR EXAMPLE: If input 1 is a 4 to 20 mA signal, but the signal represents a type "K" thermocouple; select "K TC H" and the controller will characterize the 4 to 20 mA signal so that it is treated as a type "K" thermocouple input (high range). Parameter definitions are the same as shown in Lower Display Prompt "IN1 TYPE"
IN1 HI	–999 to 9999 in Engineering units	**INPUT 1 HIGH RANGE VALUE** in engineering units. Available only if Linear or Square Root transmitter characterization is selected. Scale the #1 input signal to the display value you want for 100%. EXAMPLE: Actuation (Input) = 4 to 20 mA Process Variable = Flow Range of Flow = 0 to 250 Gal/Min High Range display value = 250 Low Range display value = 0 Then 20 mA = 250 Gal/Min The control setpoint will be limited by the range of units selected here.
IN1 LO	–999 to 9999 in Engineering units	**INPUT 1 LOW RANGE VALUE** in engineering units. Available only if Linear or Square Root transmitter characterization is selected. Scale the #1 input signal to the display value you want for 0%. See example on previous page. The control setpoint for Input 1 will be limited by the range of units selected here.
BIAS IN1	–999 to 9999	**BIAS ON INPUT 1** - Bias is used to compensate the input for drift of an input value due to deterioration of a sensor, or some other cause. Select the bias value you want on the input designated.
FILTER 1	0 to 120 seconds No filter = 0	**FILTER FOR INPUT 1** - A software digital filter is provided for the Input designated to smooth the input signal. You can configure the first order lag time constant from 1 to 120 seconds. If you do not want filtering, enter 0.

Continued on next page

Table 4-7 Input 1 Group definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
BURNOUT1		**BURNOUT PROTECTION (SENSOR BREAK)** provides most input types with upscale or downscale protection if the input fails. 1-5V, 0-10V, or 4-20mA inputs require no burnout or "NONE" selection.
	NONE	**NO BURNOUT** — Pre-configured Failsafe output applied if failed input is detected. Error message "INPUT1 FAIL" is flashed on the lower display intermittently every 10 seconds.
	UP	**UPSCALE BURNOUT** will make the PV signal increase to full scale when a sensor fails, and flash "INPUT1 FAIL" on the lower display intermittently every 10 seconds. The controller remains in Automatic control mode and adjusts the controller output signal in response to the full scale PV signal developed by the Burnout circuitry.
	DOWN	**DOWNSCALE BURNOUT** will make the PV signal decrease to the lower range value when a sensor fails, and flash "INPUT1 FAIL" on the lower display intermittently every 10 seconds. The controller remains in Automatic control mode and adjusts the controller output signal in response to the zero percent PV signal developed by the Burnout circuitry. NOTE: For no Burnout, i.e. "None," to function properly on a 4-20MA input, there must be a dropping resistor directly across the *input* terminals (i.e., not remote), then the unit can detect the "zero" voltage that occurs when the 4-20 mA line is opened.
EMISSIV1	0.01 to 1.00	**EMISSIVITY** is a correction factor applied to the Radiamatic input signal that is the ratio of the actual energy emitted from the target to the energy which would be emitted if the target were a perfect radiator. Available only for "Radiamatic" inputs.

4.9 Input 2 Parameters Set Up Group

Introduction

These are the parameters required for input 2: actuation, transmitter characterization, high and low range values in engineering units, Ratio, Bias, Filter, Burnout.and Emissivity.

Input 2 group prompts

Table 4-8 lists all the function prompts in the Input 2 setup group and their definitions.

Table 4-8 Input 2 Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
IN 2TYP		**INPUT 2 ACTUATION TYPE** -- This selection determines what actuation you are going to use for input two.
	B TC	B thermocouple 105 to 3300°F 41 to 1816°C
	E TC H	E thermocouple high −454 to 1832°F −270 to 1000°C
	E TC L	E thermocouple low −200 to 1100°F −129 to 593°C
	J TC H	J thermocouple high 0 to 1600°F −18 to 871°C
	J TC L	J thermocouple low 20 to 770°F −7 to 410°C
	K TC H	K thermocouple high 0 to 2400°F −18 to 1316°C
	K TC L	K thermocouple low −20 to 1000°F −29 to 538°C
	NNM H	NiNiMo thermocouple high 32 to 2500°F 0 to 1371°C
	NNM L	NiNiMo thermocouple low 32 to 1260°F 0 to 682°C
	NIC TC	Nicrosil-Nisil thermocouple 0 to 2372°,F −17.8 to 1300°C
	R TC	R thermocouple 0 to 3100°F −18 to 1704°C
	S TC	S thermocouple 0 to 3100°F −18 to 1704°C
	T TC H	T thermocouple high −300 to 700°F −184 to 371°C
	T TC L	T thermocouple low −200 to 600°F −129 to 316°C
	W TC H	W5W26 thermocouple high 0 to 4200°F −18 to 2316°C
	W TC L	W5W26 thermocouple low 0 to 2240°F −18 to 1227°C
	100 PT	100 Ohm–RTD −300 to 900°F −184 to 482°C
	100 LO	100 Ohm RTD low 0 to 300°F −18 to 149°C
	200PT	200 Ohm - RTD −300 to 900°F −184 to 482°C
	500 PT	500 Ohm–RTD −300 to 1200°F −184 to 649°C
	RADIAM	Radiamatic (RH) 1400 to 3400°F 760 to 1871°C
	4-20mA	4 to 20 Milliamps
	10M	0 to 10 Millivolts
	10-50M	10 to 50 Millivolts
	0-5	0 to 5 Volts
	1-5 V	1 to 5 Volts
	0-10 V	0 to 10 Volts
	CARBON	
	OXYGEN	

Table 4-8 continued on next page

4.9 Input 2 Parameters Set Up Group, Continued

Table 4-8 Input 2 Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
XMITTER 2		**TRANSMITTER CHARACTERIZATION** — This selection lets you instruct the controller to characterize a linear input to represent a non-linear one.
	B TC E TC H E TC L J TC H J TC L K TC H K TC L NNM H NNM L NIC TC R TC S TC T TC H T TC L W TC H W TC L 100 PT 500 PT 100 LO 200PT LINEAR SQROOT	NOTE: Prompt only appears when a linear actuation is selected at prompt 'IN2 TYPE". FOR EXAMPLE: If input 1 is a 4 to 20 mA signal, but the signal represents a type "K" thermocouple; select "K TC H" and the controller will characterize the 4 to 20 mA signal so that it is treated as a type "K" thermocouple input (high range). Parameter definitions are the same as shown in Lower Display Prompt "IN2 TYPE"
IN2 HI	–999 to 9999 in Engineering units	**INPUT 2 HIGH RANGE VALUE** in engineering units is displayed for Input 2 but can only be configured for linear or square root only. Scale the #2 input signal to the display value you want for 100%.
IN2 LO	–999 to 9999 in Engineering units	**INPUT 2 LOW RANGE VALUE in** engineering units is displayed for Input 2 but can only be configured for linear or square root,only. Scale the #2 input signal to the display value you want for 0%.
RATIO 2	–20.00 TO +20.00	**INPUT 2 RATIO VALUE** - Used when Input 2 operates as a remote setp[oint, prompt "RSP". This ratio value can be applied to the remote setpoint. It establishes the correct relationship between the remote setpoint and the Input 2 signal applied according to the formula: (RATIO x INPUT 2)+ BIAS = REMOTE SETPOINT
BIAS UNIT	ENGR PCT	**BIAS UNITS -** expressed in: ENGR - Engineering Units PCT - Percent
BIAS IN2	–999 to 9999 in Engineering units	**INPUT 2 BIAS VALUE** - Used when Input 2 operates as a remote setpoint, prompt "RSP". Bias, together with ratio, establishes the correct relationship between the remote setpoint and the Input 2 signal applied according to the formula: (RATIO x INPUT 2)+ BIAS = REMOTE SETPOINT
FILTER 2	0 to 120 seconds No filter = 0	**FILTER FOR INPUT TWO** — A software digital filter is provided for input 2 to smooth the input signal. You can configure the first order lag constant from 1 to 120 seconds. If you do not want filtering, enter 0.

Table 4-8 continued on next page

Table 4-8 Input 2 Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
BURNOUT2		**BURNOUT PROTECTION (SENSOR BREAK)** - provides all input types with upscale or downscale protection if the input fails.
	NONE	**NO BURNOUT** - Failsafe output applied for failed input but not out of range.
	UP	**UPSCALE BURNOUT** - will make the indicated PV signal increase when a sensor fails, and flash in the upper display. Do not use for Linear Input.
	DOWN	**DOWNSCALE BURNOUT** - will make the indicated PV signal decrease when a sensor fails, and flash the upper display. Do not use for Linear Input.
EMISSIV 2	0.01 to 1.00	**EMISSIVITY FOR (RH) RADIAMATIC INPUTS -** A radiamatic pyrometer converts radiant energy emitted by a target into electrical energy. Emissivity is a correction factor applied to the radiamatic input signal that is the ratio of the actual energy emitted from the target to the energy which would be emitted if the target were a perfect radiator. Only available on Input 2 "RH" Radiamatic.

4.10 Input 3 Parameters Setup Group

Introduction

These are the parameters required for input 3: transmitter characterization, high and low range values in engineering units, Ratio, Bias, and Filter.

Input 2 group prompts

Table 4-9 lists all the function prompts in the Input 3 setup group and their definitions.

Table 4-9 Input 3 Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
XMITTER 3	B TC S TC E TC H T TC H E TC L T TC L J TC H W TC H J TC L W TC L K TC H 100 PT K TC L 500 PT NNM H 100 LO NNM L 200PT NIC TC LINEAR R TC SQROOT	**TRANSMITTER CHARACTERIZATION** — This selection lets you instruct the controller to characterize a linear input to represent a non-linear one. FOR EXAMPLE: If input 1 is a 4 to 20 mA signal, but the signal represents a type "K" thermocouple; select "K TC H" and the controller will characterize the 4 to 20 mA signal so that it is treated as a type "K" thermocouple input (high range).
IN3HI	–999 to 9999 in Engineering units	**INPUT 3 HIGH RANGE VALUE** in engineering units is displayed for Input 3 but can only be configured for linear or square root only. Scale the #3 input signal to the display value you want for 100%.
IN3LO	–999 to 9999 in Engineering units	**INPUT 3 LOW RANGE VALUE in** engineering units is displayed for Input 3 but can only be configured for linear or square root,only. Scale the #3 input signal to the display value you want for 0%.
RATIO 3	–20.00 TO +20.00	**INPUT 3 RATIO VALUE** - used when input 3 operates as a remote setpoint. This ratio value can be applied to the remote setpoint. It establishes the correct relationship between the remote setpoint and the input 3 signal applied according to the formula: (RATIO x INPUT 3) + BIAS = SETPOINT
BIAS IN3	–999 to 9999 in Engineering units	**INPUT 3 BIAS VALUE** - used when input 3 operates as a remote setpoint. Bias, together with Ratio establishes the correct relationship between the remote setpoint and the input 3 signal applied according to the formula: (RATIO x INPUT 3) + BIAS = SETPOINT
FILTER 3	0 to 120 seconds No filter = 0	**FILTER FOR INPUT 3** — A software digital filter is provided for input 3 to smooth the input signal. You can configure the first order lag constant from 1 to 120 seconds. If you do not want filtering, enter 0.

4.11 Control Parameters Set Up Group

Introduction

The functions listed in this group deal with how the Single Loop Process Controller or Loop 1 of a Two Loop Process controller will control the process including: Number of tuning parameter sets, Setpoint source, Tracking, Power-up recall, Setpoint limits, Output direction, rate and limits, Dropoff, Deadband and Hysteresis.

Control group prompts

Table 4-10 lists all the function prompts in the Control setup group and their definitions.

Table 4-10 Control Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PID SETS		**NUMBER OF TUNING PARAMETER SETS** — This selection lets you choose one or two sets of tuning constants (gain, rate, and reset).
	1 ONLY	**ONE SET ONLY** — Only one set of tuning parameters is available. Configure the values for: Gain (proportional band), Rate, Reset Time, and Cycle Time (if time proportional is used).
	2KEYBD	**TWO SETS KEYBOARD SELECTABLE** — Two sets of tuning parameters can be configured and can be selected at the operator interface or by using the Digital Inputs. Press LOWR DISP key until you see "PID SET1" or "PID SET2" to switch between sets. Configure the values for: Gain, Rate , Reset, Cycle Time Gain #2, Rate #2, Reset#2, Cycle#2 Time See Subsection 5.10 for procedure.
	2PV SW	**TWO SETS PV AUTOMATIC SWITCHOVER** — When the process variable is *GREATER* than the value set at prompt "SW VALUE" (Switchover Value), the controller will use Gain, Rate, Reset, and Cycle Time. The active PID SET can be read in the lower display. When the process variable is *LESS* than the value set at prompt "SW VALUE," the controller will use Gain #2, Rate #2, Reset #2, and Cycle #2 Time. The active PID SET can be read in the lower display. Other prompts affected: SW VALUE
	2SP SW	**TWO SETS SP AUTOMATIC SWITCHOVER** — When the setpoint is *GREATER* than the value set at prompt "SW VALUE" (Switchover Value), the controller will use Gain, Rate, Reset, and Cycle. When the setpoint is *LESS* than the value set at prompt "SW VALUE," the controller will use Gain #2, Rate #2, Reset #2, and Cycle #2. Other prompts affected: SW VALUE

Table 4-10 continued on next page

4.11 Control Parameters Set Up Group, Continued

Table 4-10 Control Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
SW VALUE	Value in engineering units	**AUTOMATIC SWITCHOVER VALUE** —This is the value of Process Variable or Setpoint at which the controller will switch from Tuning Constant Set #2 to Set #1. Only appears when PID SETS selections "2PV SW" or "2SP SW" are selected.
LSP's		**LOCAL SETPOINT SOURCE** — This selection determines what your local setpoint source will be; One local or Two local. Toggled by SP1/SP2 key.
	1ONLY	**LOCAL SETPOINT** — The setpoint entered from the keyboard.
	TWO	**TWO LOCAL SETPOINTS** — This selection lets you switch between two local setpoints using the [SP1/SP2] key.
	THREE	**THREE LOCAL SETPOINTS** — Setpoint 3 toggled by RSP key. LSP 3 is mutually exclusive with RSP or Internal Cascade.
RSP SOURC		**REMOTE SETPOINT SOURCE** — this selection determines what your remote setpoint source will be when toggled by the RSP key or Digital Input.
	NONE	**NONE** - No remote setpoint
	IN 2	**IN 2** - Remote Setpoint using Input 2 toggled by the RSP key (not available for 2loops or cascade units)
	IN 3	**IN 3** - Remote Setpoint using Input 3 toggled by the RSP key
AUTO BIAS		**AUTO BIAS** — is used for bumpless transfer when transferring from local setpoint to remote setpoint. Auto Bias calculates and adds a bias to remote setpoint input each time a transfer is made.
	ENABLE	**ENABLE** -enables auto bias
	DISABLE	**DISABLE** - disable auto bias.
SP TRACK		**SETPOINT TRACKING** — The local setpoint can be configured to track either PV or RSP as listed below:
	NONE	**NO TRACKING** — If local setpoint tracking is not configured, the LSP will not be altered when transfer from RSP to LSP is made.
	PV	**PV** - Local setpoint tracks the PV when in manual.
	RSP	**RSP** - Local setpoint tracks remote setpoint. When the controller transfers out of remote setpoint, the last value of the remote setpoint (RSP) is inserted into the local setpoint.

Table 4-10 continued on next page

Table 4-10 Control Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PWR MODE		**POWER UP CONTROLLER MODE RECALL** — This selection determines which mode and setpoint the controller will use when the controller restarts after a power loss. Select one from below:
	MANUAL	**MANUAL, LSP** — At power-up, the controller will use *manual* mode with the local setpoint displayed.
	A M SP	**LAST MODE/LAST SETPOINT** used before power down.
	AM LSP	**LAST MODE/LAST LOCAL SETPOINT** on power down.
PWR OUT		**POWER UP OUTPUT SELECTION** - This selection determines what output the controller will go to upon power up.
	LAST	LAST - Last output prior to power down
	F'SAFE	F'SAFE - Failsafe Output
SP HILIM	0 to 100% of span input in engineering units with decimal place	**SETPOINT HIGH LIMIT*** — This selection prevents the local and remote setpoints from going above the value selected here. The setting must be equal to or less than the upper range of the inputs.
SP LOLIM	0 to 100% of span input in engineering units with decimal place	**SET POINT LOW LIMIT*** — This selection prevents the local and remote setpoints from going below the value selected here. The setting must be equal to or greater than the lower range of the inputs.
*The Local Setpoint will automatically adjust itself to be within the setpoint limit range. For example, if SP = 1500 and the SP HILIM is changed to 1200, the new Local Setpoint will be 1200.		
ACTION		**CONTROL OUTPUT DIRECTION** — In what direction do you want the controller output to go when the process variable increases.
	DIRECT	**DIRECT ACTING CONTROL** — The controller's output increases as the process variable increases.
	REVERSE	**REVERSE ACTING CONTROL** — The controller's output decreases as the process variable increases.
OUT HI LIM	–5.0 to 105.0% of output	**HIGH OUTPUT LIMIT** — This is the highest value of output beyond which you do not want the controller automatic output to exceed. Use 0 to 100% for Time Proportional output type. Use 5 to 105% for current output.

Table 4-10 continued on next page

Table 4-10 Control Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
OUT LO LIM	–5.0 to 105.0% of output	**LOW OUTPUT LIMIT** — This is the lowest value of output below which you do not want the controller automatic output to exceed. Use 0 to 100% for Time Proportional output type. Use 5 to 105% for current output.
I HI LIM	Within the range of the output limits	**HIGH RESET LIMIT** - this is the highest value of output beyond which you want no reset to occur.
I LOLIM	Within the range of the output limits	**LOW RESET LIMIT** - this is the lowest value of output beyond which you want no reset to occur.
DROPOFF	–5 to 105.0% of output	**CONTROLLER DROPOFF VALUE** — output value that below which the controller output will dropoff to the low output limit value set in prompt "OUT LOLIM."
DEADBAND		**DEADBAND** is an adjustable gap between the operating ranges of output 1 and output 2 in which neither output operates (positive value) or both outputs operate (negative value).
	–5.0 to 25.0%	Duplex
	0 to 25.0%	all others
OUT HYST	0.0 to 5.0% of PV span for ON/OFF control	HYSTERESIS (OUTPUT RELAY ONLY) - is an adjustable overlap of the ON/OFF states of each control relay. This is the difference between the value of the process variable at which the control relay(s) energize and the value at which they de-energize. Only applicable for ON/OFF control.
FAILSAFE	0 to 100%	**FAILSAFE OUTPUT VALUE** — The value used here will also be the output level when you have Communications SHED or when NO BURNOUT is configured and input 1 fails.

Table 4-10 continued on next page

Table 4-10 Control Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PROP BDor GAIN*		**PROPORTIONAL BAND UNITS** — Select one of the following for the Proportional (P) term of the PID algorithm:
	PROP BD	**PROPORTIONAL BAND** — Selects units of percent proportional band for the P term of the PID algorithm. Where: $PB\% = \frac{100\%FS}{GAIN}$
	GN	**GAIN** selects the unitless term of gain for the P term of the PID algorithm. Where: $GAIN = \frac{100\%FS}{PB\%}$
MINorRPM*		**RESET UNITS** — Selects units of minutes or repeat per minutes for the I term of the PID algorithm. 20 Repeats per Minute = 0.05 Minutes per Repeat.
	RPM	**REPEATS PER MINUTE** — The number of times per minute that the proportional action is repeated by reset.
	MIN	**MINUTES PER REPEAT** — The time between each repeat of the proportional action by reset.
*Selection here is used for both Loop 1 and Loop 2 if available.		

4.12 Control2 Parameters Set Up Group

Introduction

The functions listed in this group deal with how **Loop 2** of a Two Loop Process controller will control the process including: PV Source, Number of tuning parameter sets, Setpoint source, Tracking, Power-up recall, Setpoint limits, Output direction, Rate and limits, Dropoff, Deadband and Hysteresis.

Control2 group prompts

Table 4-11 lists all the function prompts in the Control2 setup group and their definitions.

Table 4-11 Control2 Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PV2 SRC		**PROCESS VARIABLE2 SOURCE -** select the source of the Process Variable for Loop 2.
	INPUT 1	**INPUT 1**
	INPUT 2	**INPUT 2**
	INPUT 3	**INPUT 3**
PID SETS		**NUMBER OF TUNING PARAMETER SETS** — This selection lets you choose one or two sets of tuning constants (gain, rate, and reset).
	1 ONLY	**ONE SET ONLY** — Only one set of tuning parameters is available. Configure the values for: Gain (proportional band) Rate Reset Time Cycle Time (if time proportional is used)
	2KEYBD	**TWO SETS KEYBOARD SELECTABLE** — Two sets of tuning parameters can be configured and can be selected at the operator interface or by using the Digital Inputs. Press LOWR DISP key until you see "PID SET3" or "PID SET4" to switch between sets. Configure the values for: Gain#3, Rate#3 , Reset#3, Cycle3Time Gain #4, Rate #4, Reset#4, Cycle#4 Time See Subsection 5.10 for procedures.
	2PV SW	**TWO SETS PV AUTOMATIC SWITCHOVER** — When the process variable is *GREATER* than the value set at prompt "SW VALUE" (Switchover Value), the controller will use Gain3, Rate3, Reset3, and Cycle 3Time. The active PID SET can be read in the lower display. When the process variable is *LESS* than the value set at prompt "SW VALUE," the controller will use Gain #4, Rate #4, Reset #4, and Cycle #4 Time. The active PID SET can be read in the lower display. Other prompts affected: SW VALUE

Table 4-11 continued on next page

Table 4-11 Control2 Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PID SETS (CONTINUED	2SP SW	**TWO SETS SP AUTOMATIC SWITCHOVER** — When the setpoint is *GREATER* than the value set at prompt "SW VALUE" (Switchover Value), the controller will use Gain3, Rate3, Reset3, and Cycle3. When the setpoint is *LESS* than the value set at prompt "SW VALUE," the controller will use Gain #4, Rate #4, Reset #4, and Cycle #4. Other prompts affected: SW VALUE
SW VALUE	Value in engineering units	**AUTOMATIC SWITCHOVER VALUE** —This is the value of Process Variable or Setpoint at which the controller will switch from Tuning Constant Set #4 to Set #3. Only appears when PID SETS selections "2PV SW" or "2SP SW" are selected.
LSP's		**LOCAL SETPOINT SOURCE** — This selection determines what your local setpoint source will be; One local or Two local. Toggled by the SP1/SP2 key.
	1ONLY	**LOCAL SETPOINT** — The setpoint entered from the keyboard.
	TWO	**TWO LOCAL SETPOINTS** — This selection lets you switch between two local setpoints using the SP1/SP2 key.
	THREE	**THREE LOCAL SETPOINTS** — Setpoint 3 toggled by SP1/SP2 key. LSP 3 is mutually exclusive with RSP or Internal Cascade.
RSP SOURC		**REMOTE SETPOINT SOURCE** — this selection determines what your remote setpoint source will be when toggled by the RSP key.
	NONE	**NONE** - No remote setpoint
	IN 3	**IN 3** - Remote Setpoint using Input 3 toggled by RSP key.
	IN 2	**IN 2**- Remote Setpoint using Input 2 toggled by RSP key.

Table 4-11 continued on next page

Table 4-11 Control2 Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
AUTO BIAS		**AUTO BIAS** — is used for bumpless transfer when transferring from local setpoint to remote setpoint. Auto Bias calculates and adds a bias to remote setpoint input each time a transfer is made.
	ENABLE DISABLE	**ENABLE** -enables auto bias **DISABLE** - disable auto bias.
SP TRACK		**SETPOINT TRACKING** — The local setpoint can be configured to track either PV or RSP as listed below:
	NONE	**NO TRACKING** — If local setpoint tracking is not configured, the LSP will not be altered when transfer from RSP to LSP is made.
	PV	**PV** - Local setpoint tracks the PV when in manual.
	RSP	**RSP** - Local setpoint tracks remote setpoint. When the controller transfers out of remote setpoint, the last value of the remote setpoint (RSP) is inserted into the local setpoint.
PWR MODE		**POWER UP CONTROLLER MODE RECALL** — This selection determines which mode and setpoint the controller will use when the controller restarts after a power loss. Select one from below:
	MANUAL	**MANUAL, LSP** — At power-up, the controller will use *manual* mode with the local setpoint displayed.
	A M SP	**LAST MODE/LAST SETPOINT** used before power down.
	AM LSP	**LAST MODE/LAST LOCAL SETPOINT** on power down.
PWR OUT		**POWER UP OUTPUT SELECTION** - This selection determines what output the controller will go to upon power up.
	LAST F'SAFE	LAST - Last output prior to power down F'SAFE - Failsafe Output
SP HILIM	0 to 100% of span input in engineering units with decimal place	**SETPOINT HIGH LIMIT*** — This selection prevents the local and remote setpoints from going above the value selected here. The setting must be equal or less than the upper range of the inputs.
SP LOLIM	0 to 100% of span input in engineering units with decimal place	**SET POINT LOW LIMIT*** — This selection prevents the local and remote setpoints from going below the value selected here. The setting must be equal to or greater than the lower range of the inputs.

*The Local Setpoint will automatically adjust itself to be within the setpoint limit range. For example, if SP = 1500 and the SP HILIM is changed to 1200, the new Local Setpoint will be 1200.

Table 4-11 continued on next page

Table 4-11 Control2 Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
ACTION		**CONTROL OUTPUT DIRECTION** — In what direction do you want the controller output to go when the process variable increases.
	DIRECT	**DIRECT ACTING CONTROL** — The controller's output increases as the process variable increases.
	REVERSE	**REVERSE ACTING CONTROL** — The controller's output decreases as the process variable increases.
OUT HI LIM	–5.0 to 105.0% of output	**HIGH OUTPUT LIMIT** — This is the highest value of output beyond which you do not want the controller automatic output to exceed. Use 0 to 100% for digital output type. Use 5 to 105% for current output.
OUT LO LIM	–5.0 to 105.0% of output	**LOW OUTPUT LIMIT** — This is the lowest value of output below which you do not want the controller automatic output to exceed. Use 0 to 100% for digital output type. Use 5 to 105% for current output.
I HI LIM	Within the range of the output limits	**HIGH RESET LIMIT** - this is the highest value of output beyond which you want no reset to occur.
I LOLIM	Within the range of the output limits	**LOW RESET LIMIT** - this is the lowest value of output beyond which you want no reset to occur.
DROPOFF	–5 to 105.0% of output	**CONTROLLER DROPOFF VALUE** — output value that below which the controller output will dropoff to the low output limit value set in prompt "OUT LOLIM."
DEADBAND		**DEADBAND** is an adjustable gap between the operating ranges of output 1 and output 2 in which neither output operates (positive value) or both outputs operate (negative value).
	–5.0 to 25.0%	Time Duplex
	0 to 25.0%	On-Off Duplex
FAILSAFE	0 to 100%	**FAILSAFE OUTPUT VALUE** — The value used here will also be the output level when you have Communications SHED or when NO BURNOUT is configured and input 1 fails.

4.13 Options Set Up Group

Introduction

Configure the Digital Input to a specific contact closure response, or configure the Auxiliary Output to be a specific selection with desired scaling.

Table 4-12 lists all the function prompts in the "OPTION" setup group and their functions.

Table 4-12 Option Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
AUX OUT		**AUXILIARY OUTPUT -** can represent one of seven control parameters. The display for auxiliary output viewing will be in engineering units for all but output. Output will be in percent. Other prompts affected by these selections: "4mA VAL" and "20mA VAL."
	DISABL	**NO AUXILIARY OUTPUT**
	IN 1	**INPUT 1** represents the value of the configured range of input 1.
	IN 2	**INPUT 2** represents the value of the configured range of input 2.
	IN 3	**INPUT 3** represents the value of the configured range of input 3.
	PV	**PROCESS VARIABLE** — Represents the value of the Process Variable.
	DEV	**DEVIATION (PROCESS VARIABLE MINUS SETPOINT)** — Represents –100 to +100% of the selected PV span in engineering units for Loop 1.. When Deviation is selected, only one operating parameter will be entered. This value represents the deviation level that will produce 20mA output. Zero deviation will produce a center scale (12mA) output. A negative deviation equal in magnitude to the 2nd current output high value will produce a low end (4mA) output.
	OUTPUT	**OUTPUT** — Represents the displayed controller output in percent (%) for Loop 1.
	SP	**SETPOINT** — Represents the value of the setpoint in units of PV for Loop 1.

Table 4-12 continued on next page

Table 4-12 Option Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
AUXOUT (continued)	PV 2	**PROCESS VARIABLE** — Represents the value of the Process Variable.for Loop 2.
	DEV 2	**DEVIATION 2 (PROCESS VARIABLE MINUS SETPOINT)** — Represents –100 to +100% of the selected PV span in engineering units for Loop 2. When Deviation is selected, only one operating parameter will be entered. This value represents the deviation level that will produce 20mA output. Zero deviation will produce a center scale (12mA) output. A negative deviation equal in magnitude to the 2nd current output high value will produce a low end (4mA) output.
	OUT2	**OUTPUT 2** — Represents the displayed controller output in percent (%) for Loop 2.
	SP 2	**SETPOINT 2**— Represents the value of the setpoint in units of PV for Loop 2.
4mA VAL	Low Scale Value within the range of the selected variable to represent 4 mA	**AUXILIARY OUTPUT LOW SCALING FACTOR** — Use a value in engineering units to represent all above except output. Use value in percent (%) for Output. (Output can be between –5 and +105%.)
20mA VAL*	High Scale Value within the range of the selected variable to represent 20 mA	**AUXILIARY OUTPUT HIGH SCALING FACTOR** — Use a value in engineering units to represent all above except output. Use a value in percent (%) for Output. (Output can be between –5 and +105%.) *When Deviation is selected, only one operating parameter will be entered. This value represents the deviation level that will produce 20 mA output. Zero deviation will produce a center scale (12 mA) output. A negative deviation equal in magnitude to the Auxiliary Output High Value will produce a low end (4 mA) output.
REM SW1		**DIGITAL INPUT ONE SELECTIONS** — Contact closure enables one of the following (applies to Loop 1 on 2 Loop models). The controller returns to its original state when contact opens, except when overruled by the keyboard. **ATTENTION** If the controller is configured for "Cascade" or "2 Loop" control, switch #1 operates only Loop 1; switch 2 operates only on Loop 2.
	NONE	**NO DIGITAL INPUT SELECTIONS**
	To MAN	**TO MANUAL** — Contact closure puts the controller into manual mode.

Table 4-12 continued on next page

Table 4-12 Option Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
REM SW1 continued		
	To SP1	**TO LOCAL SETPOINT** — Contact closure puts the controller into local setpoint 1.
	To SP2	**TO LOCAL SETPOINT TWO** — Contact closure puts the controller into local setpoint 2.
	To DIR	**TO DIRECT ACTION** — Contact closure selects direct controller action.
	ToHOLD	**TO HOLD** — Contact closure suspends Setpoint Ramp/Program. Contact open runs ramp/program.
	ToPID2	**TO PID2** — Contact closure selects PID Set 2.
	PV IN2 *	**PV = INPUT 2**-Contact Closure selects PV = Input 2.
	PV IN3 *	**PV = INPUT 3**-Contact Closure selects PV = Input 3.
	To RUN	**RUN** — Contact closure starts a stopped SP RAMP.
	To BGN	**TO BEGIN** — Resets the SP Program to the setpoint at the beginning of the program without any change in mode or program status.
REM SW2		**DIGITAL INPUT TWO SELECTIONS** — Same selections as REM SW1. Digital Input 2 is reserved for Loop 2 parameters when Two Loops or Internal Cascade is configured. **ATTENTION** Digital Input #1 has priority over Digital Input #2.

* When an Input combination algorithm has been selected, selections PV IN2 and PV IN3 will result in the "PV LIMIT" error message. For example, selecting Carbon Potential as the second input algorithm will not permit selection "PV INPUT 2" to function.

4.14 Communications Set Up Group

Introduction

This option allows the controller to be connected to a host computer via a RS422/485 or DMCS bus.
Thirty-one units (DMCS) or Fifteen units (RS422) can be configured over this link.
The controller looks for messages from the computer at regular intervals. If these messages are not received within the configured shed time, the controller will SHED from the communications link and return to stand alone operation. The Device address, Parity, Baud rate, Computer Setpoint, Units, Ratio, and Bias are configurable depending on the protocol you are using.
You can also set the SHED output mode and setpoint recall and communication units.

Communications group prompts

Table 4-13 lists all the function prompts in the Communications setup group and their definitions.

Table 4-13 Communications Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
ComSTATE	 DISABL DMCS RS-422/485	**COMMUNICATIONS SELECTION** **DISABL** — Disables the communications option. **DMCS** — Allows DMCS communication prompts. **RS-422/485** — Allows RS422/485 communication prompts.
ComADDR	1 to 31 (DMCS) 1 to 99 (RS422)	**COMMUNICATIONS STATION ADDRESS** (LOOP 1) — This is a number that is assigned to a controller that is to be used with the communications option. This number will be its address. Must be different addresses for 2 Loops on RS422/485.
ComADDR2	1 to 31 (DMCS) 1 to 99 (RS422)	**COMMUNICATIONS STATION ADDRESS** (LOOP 2) — This is a number that is assigned to a controller that is to be used with the communications option. This number will be its address. Must be different addresses for 2 Loops on RS422/485.
SHEDTIME	0 to 255	**SHED TIME** — The number that represents how many sample periods there will be before the controller sheds from communications. Each period equals 1/3 seconds or 0 = No shed.
PARITY **(RS422/485 only)**	 ODD EVEN	**PARITY** pertains to the use of a self-checking code employing binary digits in which the total number of ONE's (or ZERO's) in each permissible code expression is either ODD or EVEN. **ODD PARITY** **EVEN PARITY**

Table 4-13 continued on next page

Table 4-13 Communications Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
BAUD **(RS422/485 only)**		**BAUD RATE** is the transmission speed in bits per second.
	300	**300 BAUD**
	600	**600 BAUD**
	1200	**1200 BAUD**
	2400	**2400 BAUD**
	4800	**4800 BAUD**
	9600	**9600 BAUD**
	19200	**19200 BAUD**
SHEDMODE **(DMCS only)**		**SHED CONTROLLER MODE AND OUTPUT LEVEL** — determines the mode of local control you want when the controller is shed from the communications link.
	LAST	**LAST** -SAME MODE AS BEFORE SHED - The controller will return to the same mode (manual or automatic) that it was in before shed.
	TO MAN	**TO MAN** — TO MANUAL MODE BUMPLESS OUTPUT - The controller will return to manual mode at the same output level that it had before shed.
	FSAFE	**FSAFE** — TO MANUAL MODE, FAILSAFE OUTPUT - The controller will return to manual mode at the output value selected at "CONTROL" prompt "FAILSAFE".
	TO AUTO	**TO AUTOMATIC MODE**— The controller will return to automatic mode when the controller is shed from communications.
SHED SP **(DMCS only)**		**SHED SP** — Shed setpoint (DMCS only).
	TO LSP	**TO LSP** — Controller will use last local SP used.
	TO CSP	**TO CSP** — Controller will use computer setpoint.
UNITS		**COMMUNICATION UNITS** — This selection determines how the controller values are expressed during communications.
	PERCNT	**PERCENT OF SPAN**
	ENG UNITS	**ENGINEERING UNITS**
CSRATIO	–20.00 TO 20.00	**LOOP 1 COMPUTER SETPOINT RATIO -** Computer Setpoint ratio for Loop 1.
CS BIAS	–999.0 to 9999 Eu –999 to 2000% of CSP Span	**LOOP 1 COMPUTER SETPOINT BIAS -** Computer Setpoint Bias for Loop 1.
CSRATIO2	–20.00 TO 20.00	**LOOP 2 COMPUTER SETPOINT RATIO -** Computer Setpoint ratio for Loop 2.
CSBIAS2	–999.0 to 9999 Eu –999 to 2000% of CSP Span	**LOOP 2 COMPUTER SETPOINT BIAS -** Computer Setpoint Bias for Loop 2.

Continued on next page

Table 4-13 Communications Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
DMCS SW		**DMCS TYPE SELECTION -** Choose from the following:
	ULTRA	**ULTRA** - only UDC5000 Ultra-Pro databases accepted on downloads
	5000	**5000** - All UDC5000 databases accepted on downloads.
LOOPBACK		**LOCAL LOOPBACK** tests the communications hardware.
	ENABLE	**ENABLE** — Allows loopback test. The UDC goes into Loopback mode in which it sends and receives its own message. The UDC displays "PASS" or "FAIL" in the upper display and "LOOPTEST" in the lower display as long as the test is running. The UDC will go into manual mode. The test will run until the operator disables it here.
	DISABL	**DISABLE** - disables the Loopback test.

4.15 Alarms Set Up Group

Introduction

An alarm is an indication that an event that you have configured (for example—Process Variable) has exceeded one or more alarm limits. There are two alarms available. Each alarm has two setpoints. You can configure each of these two setpoints to alarm on various controller parameters.

There are two alarm output selections, High and Low. You can configure each setpoint to alarm either High or Low.

Alarms group prompts

Table 4-14 lists all the function prompts in the Alarms setup group and their definitions.

Table 4-14 Alarms Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
A1S1 VAL	Value in Engineering Units	**ALARM 1 SETPOINT 1 VALUE** — This is the value at which you want the alarm type chosen in Prompt "A1S1TYPE" to actuate. The value depends on what the setpoint has been configured to represent. NO setpoint is required for Communications SHED. **ATTENTION** For alarms configured for "EVENT", the value here is the segment number to which the event applies.
A1S2 VAL	Value in Engineering Units	**ALARM 1 SETPOINT 2 VALUE** — This is the value at which you want the alarm type chosen in Prompt "A1S2TYPE" to actuate. The details are the same as "A1S1 VAL".
A2S1 VAL	Value in Engineering Units	**ALARM 2 SETPOINT 1 VALUE** — This is the value at which you want the alarm type chosen in Prompt "A2S1TYPE" to actuate. The details are the same as "A1S1 VAL".
A2S2 VAL	Value in Engineering Units	**ALARM 2 SETPOINT 2 VALUE** — This is the value at which you want the alarm type chosen in Prompt "A2S2TYPE" to actuate. The details are the same as "A1S1 VAL".

Table 4-14 continued on next page

Table 4-14 Alarms Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
A1S1TYPE		**ALARM 1 SETPOINT 1 TYPE** — Select what you want Setpoint 1 of Alarm 1 to represent.
	NONE IN1 IN2 PV DEV OUTPUT SHED EV ON EV OFF IN3 PV2 DEV2 OUT2	**NO ALARM** **INPUT 1** **INPUT 2** **PROCESS VARIABLE** **DEVIATION** **OUTPUT** **SHED FROM COMMUNICATIONS** **EVENT ON (SP PROGRAMMING) *** **EVENT OFF (SP PROGRAMMING) *** **INPUT 3** **CONTROL LOOP 2 PV** **CONTROL LOOP 2 DEVIATION** **CONTROL LOOP 2 OUTPUT** * Alarm configured for Events will not operate on setpoint program segments of "0" length ATTENTION When the Alarm type is re-configured, the value of the current alarm setpoint does not automatically change to be consistent with the range of the new alarm type until it is viewed on the display.
A1S2TYPE	Same as A1S1 TYPE	**ALARM 1 SETPOINT 2 TYPE** — Select what you want Setpoint 2 of Alarm 1 to represent. The selections are the same as A1S1TYPE.
A2S1TYPE	Same as A1S1 TYPE	**ALARM 2 SETPOINT 1 TYPE** — Select what you want Setpoint 1 of Alarm 2 to represent. The selections are the same as A1S1TYPE. NOTE: Not applicable with Relay Duplex or Position Proportional outputs.
A2S2TYPE	Same as A1S1 TYPE	**ALARM 2 SETPOINT 2 TYPE** — Select what you want Setpoint 2 of Alarm 2 to represent. The selections are the same as A1S1TYPE. NOTE: Not applicable with Relay Duplex or Position Proportional outputs.
A1S1 H L		**ALARM 1 SETPOINT 1 STATE** — Select whether you want the alarm type chosen in Prompt "A1S1TYPE" to alarm High or Low.
	HI LO	**HI ALARM** **LO ALARM**

Table 4-14 continued on next page

Table 4-14 Alarms Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
A1S1EV		**ALARM 1 SETPOINT 1 EVENT -** Select the beginning or end of a segment of ramp/soak programming for the alarm to activate.
	BEGIN END	BEGIN - alarm on the beginning of a segment END - alarm on the end of the segment
A1S2 H L		**ALARM 1 SETPOINT 2 STATE** — Select whether you want the alarm type chosen in Prompt "A1S2TYPE" to alarm High or Low.
	HI LO	**HI ALARM** **LO ALARM**
A1S2EV		**ALARM 1 SETPOINT 2 EVENT -** Select the beginning or end of a segment of ramp/soak programming for the alarm to activate.
	BEGIN END	BEGIN - alarm on the beginning of a segment END - alarm on the end of the segment
A2S1 H L		**ALARM 2 SETPOINT 1 STATE** — Select whether you want the alarm type chosen in Prompt "A2S1TYPE" to alarm HIGH or LOW.
	HI LO	**HI ALARM** **LO ALARM**
A2S1EV		**ALARM 2 SETPOINT 1 EVENT -** Select the beginning or end of a segment of ramp/soak programming for the alarm to activate.
	BEGIN END	BEGIN - alarm on the beginning of a segment END - alarm on the end of the segment
A2S2 H L		**ALARM 2 SET POINT 2 STATE** — Select whether you want the alarm type chosen in Prompt "A2S2TYPE" to alarm HIGH or LOW.
	HI LO	**HI ALARM** **LO ALARM**
A2S2EV		**ALARM 2 SETPOINT 2 EVENT -** Select the beginning or end of a segment of ramp/soak programming for the alarm to activate.
	BEGIN END	BEGIN - alarm on the beginning of a segment END - alarm on the end of the segment

Table 4-14 continued on next page

Table 4-14 Alarms Group Definitions, continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
AL HYST	0.0 to 5.0% of span or full output as appropriate	**ALARM HYSTERESIS** — A single adjustable hysteresis is provided on alarms such that when the alarm is OFF it activates at exactly the alarm setpoint; when the alarm is ON, it will not deactivate until the variable is 0.0% to 5.0% away from the alarm setpoint. Configure the hysteresis of the alarms based on INPUT signals as a % of input range span. Configure the hysteresis of the alarm based on OUTPUT signals as a % of the full scale output range.
ALM ACTN		**ALARM RELAY COIL ACTION -** The alarm action is configurable for normally de-energized (Reverse) operation.
	RLY ON RLY OFF	RLY ON - Coil energized on alarm. RLY OFF - Coil de-energized on alarm.

4.16 Display Parameters Set Up Group

Introduction

This group contains selections for Decimal Place, Bargraph Representation, Units of Temperature, and Power Frequency.

Alarms group prompts

Table 4-15 lists all the function prompts in the Display setup group and their definitions.

Table 4-15 Display Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
DECIMAL		**DECIMAL POINT LOCATION** — This selection determines where the decimal point appears in the display.
	XXXX XXX.X XX.XX X.XXX	**XXXX** - No Decimal Place **XXX.X** - One Place **XX.XX** - Two Places **X.XXX** - Three Places
DECIMAL2		**CONTROL LOOP 2 DECIMAL POINT LOCATION** — This selection determines where the decimal point appears in the display for Loop 2.
	XXXX XXX.X XX.XX X.XXX	**XXXX** - No Decimal Place **XXX.X** - One Place **XX.XX** - Two Places **X.XXX** - Three Places
BARGRAPH		**BARGRAPH REPRESENTATION** - Lets you select what you want the bargraph to represent. The bargraph normally shows Output when the lower display shows deviation or setpoint.
	DEV OUTPUT DEV/OUT	**DEV** - Bargraph shows only Deviation **OUTPUT** - Bargraph shows Output **DEV/OUT** - Bargraph normally shows output when the lower display shows deviation or setpoint, otherwise the bargraph shows deviation.
UNITS		**TEMPERATURE UNITS** - This selection will affect the indication and operation. Applies to Loop 1.
	F C NONE	**F** - Degrees Fahrenheit **C** - Degrees Centigrade **NONE** - No display of units
UNITS 2		**CONTROL LOOP 2 TEMPERATURE UNITS** - This selection will affect the indication and operation. Applies to Loop 2.
	F C NONE	**F** - Degrees Fahrenheit **C** - Degrees Centigrade **NONE** - No display of units
PWR FREQ	60HZ 50HZ	**POWER FREQUENCY** - Select whether your controller is operating at 50 or 60 Hertz.

4.17 Calibration Data

Introduction

The prompts used here are for field calibration purposes. Refer to *Section 7 – Input Calibration* in this manual for complete information.

4.18 Status Test Data

Introduction

The prompts used here are for determining the reason for a controller failure. Refer to the *Section 9– Troubleshooting* in this manual for complete information.

Section 5 – Operation

5.1 Overview

Introduction

This section gives you all the information necessary to monitor and operate your controller. Review the Operator Interface shown in subsection 5.4 “Monitoring” to make sure you are familiar with the display and indicator definitions. The key functions are listed in *Section 1 - Overview.*

What’s in this section?

This section contains the following topics:

Topic		See Page
5.1	Overview	125
5.2	How to Power Up the Controller	126
5.3	How to Enter a Security Code	128
5.4	Monitoring Your Controller	129
5.5	Start-Up Procedure	133
5.6	Operating Modes	134
5.7	Setpoints	138
5.8	Alarm Setpoints	145
5.9	Single Setpoint Ramp	146
5.10	Using Two Sets of Tuning Constants	149
5.11	2 Loops of Control Overview	152
5.12	Configure 2 loops of Control	157
5.13	Monitor 2 Loops of Control	160
5.14	Operate 2 Loops of Control	161
5.15	Digital Input Option (Remote Switching)	162
5.16	Adaptive Tune	163
5.17	Autotune	170

5.2 How to Power Up The Controller

Apply power

When power is applied, the controller will run three diagnostic tests. All the displays will light and then the controller will go into automatic mode.

Diagnostic tests

Table 5-1 lists the three diagnostic tests.

Table 5-1 Power Up Diagnostic Tests

Prompt on Lower Display	Condition
RAM TEST	Checks internal memory
CONFTEST	Checks the controller's software configuration for inconsistencies.
CAL TEST	Checks calibration of the controller's configured analog inputs and outputs.

Test failures

All the displays and indicators will light and then display "TEST DONE".
If all these tests pass, the controller will function in a normal manner without any diagnostic messages.
If one or more of these tests fail, the controller will go to the Fail-safe Manual Mode, and "FAILSAFE" will flash in the lower display.

Troubleshooting

Refer to "STATUS TESTS" in *Section 9- Troubleshooting* to identify and correct the problem.

Continued on next page

5.2 How to Power Up The Controller, Continued

Check the displays and keys

Use the procedure in Table 5-2 to run the display and key test.

Table 5-2 Procedure for Testing the Displays and Keys

<table>
<tr><th>Press</th><th>Result</th></tr>
<tr><td>SET UP
and hold in,
then
FUNC
at the same time</td><td>The controller will run a display test. All the displays will light for 8 seconds, then the displays will look like this:
Upper Display
KEYS
Lower Display
TRY ALL
You will have 60 seconds to test the keys.</td></tr>
<tr><td>Press each key to see if it works</td><td>When the key is pressed, the lower display will indicate the name of the key pressed.
<table>
<tr><th>Key Pressed</th><th>Lower Display</th></tr>
<tr><td>FUNC</td><td>FUNCTION</td></tr>
<tr><td>LOWR DISP</td><td>LOWR_DISP</td></tr>
<tr><td>MAN/AUTO</td><td>AUTO_MAN</td></tr>
<tr><td>AUTO TUNE</td><td>AUTOTUNE</td></tr>
<tr><td>SET UP</td><td>_SETUP</td></tr>
<tr><td>▲</td><td>INCREMENT</td></tr>
<tr><td>▼</td><td>DECREMENT</td></tr>
<tr><td>RUN/HOLD</td><td>RUN_HOLD</td></tr>
<tr><td>ALM 1</td><td>ALARM_1</td></tr>
<tr><td>ALM 2</td><td>ALARM_2</td></tr>
<tr><td>REM SP</td><td>REMOTESP</td></tr>
<tr><td>SP1/SP2</td><td>SP1_SP2</td></tr>
<tr><td>▲ + ▼</td><td>INCR_DECR</td></tr>
<tr><td>FUNC+SETUP</td><td>FUNC SU</td></tr>
<tr><td>FUNC + ▲</td><td>FUNC_INCR</td></tr>
</table>
</td></tr>
</table>

If no key is pressed for 20 seconds, the test will time out and the controller will go into control mode.

If any test fails, go to “Controller Failure Symptoms” in *Section 9-Troubleshooting*.

Key error

When a key is pressed and the prompt “KEY ERROR” appears in the lower display, it will be for one of the following reasons:

- parameter not available,
- not in Set Up mode, press SET UP key first,
- Key malfunction, do keyboard test.

5.3 Enter a Security Code

Introduction

The LOCKOUT feature in the UDC5000 is used to inhibit changes (via keyboard) of certain functions or parameters by unauthorized personnel. There are different levels of LOCKOUT depending on the level of security required. These levels are:

NONE
CALIB
+CONF
+VIEW
MAX

See *Section 4 - Configuration Definitions* for details.

Security code numbers

The level of keyboard lockout may be changed in the Set Up mode. However, knowledge of a security code number (1 to 4095) may be required to change from one level of lockout to another.

When a controller leaves the factory, it has a security code of 0 which permits changing from one lockout level to another without entering any other code number.

Procedure

If you require the use of a security code, select a number from 0001 to 4095 and enter it when the lockout level is configured as "NONE".

Thereafter, that selected number must be used to change the lockout level from something other than "NONE".

CAUTION Write the number on the Configuration Record Sheet in the configuration section so you will have a permanent record.

Use the procedure in Table 5-3 to enter a security code.

Table 5-3 Procedure for Entering a Security Code

Step	Press	Action
1	SET UP	Until you see Upper Display SET UP Lower Display TUNING
2	FUNC	Until you see Upper Display 0 Lower Display SECURITY
3	▲ or ▼	to enter a four digit number in the upper display (1 to 4095) This will be your security code.

5.4 Monitoring Your Controller

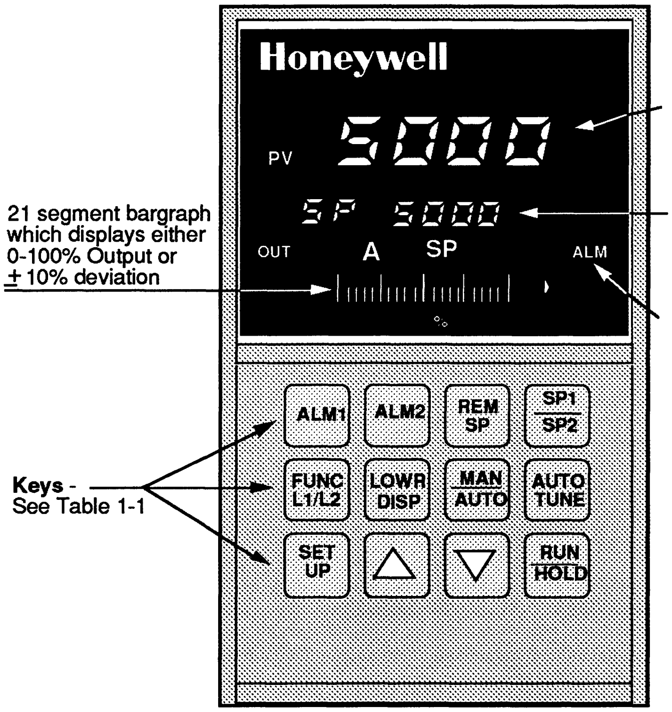
Operator Interface

The indicators and displays on the Operator Interface let you see what is happening to your process and how the controller is responding.

Figure 5-1 is a view of the Operator interface. A description of the displays and indicators is included.

When **Two Loop** or **Cascade** is configured, the left-most character shows "1" or "2" to indicate the loop being displayed.

Figure 5-1 Operator Interface



21 segment bargraph which displays either 0-100% Output or ±10% deviation

Keys - See Table 1-1

Upper Display - Six Characters
- Normal Operation - displays the process variable
- Configuration Mode - displays parameter value or selection

Lower Display - eight characters
- Normal Operation - displays operating parameters and values
- Configuration Mode - displays function groups and parameters

Indicators
- **OUT 12** = control relay 1 or 2 on - indicates Loop 1 or 2
- **MAN** = indicates conmtroller mode (manual or automatic)
- **•C** = degrees c elsius being displayed
- **2RSPC** = those lit indicate the set point being used
  - SP 1st set point
  - 2SP 2nd set point
  - RSP Remote set point or 3rd set point
  - C Computer set point
- **F** = degrees fahrenheit being displayed
- **12 Alm** = Alarm condition exists on alarm 1 or 2

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Decimal point position

In each display, when no decimal place is configured, the right-most character is blank.

When a single decimal position has been configured and values greater than 1000 are displayed, the right-most character is blank but the decimal point will be lit.

Continued on next page

Bargraph

In addition to the displays and indicators described in Figure 5-1, the Operator Interface contains a bargraph containing 21 discrete bars used to display Output, Deviation, or both depending on how it is configured.

OUTPUT	Each bar represents 5%, with 0% output at the left, and 100% output at the right The right hand arrow is always lighted.
DEVIATION	The center bar represents zero deviation. For deviations where the Process Variable (PV) is greater than the Setpoint, bars to the right of center light. When the PV is less than the setpoint, bars to the left of center light. The arrow [< or >] indicates that the deviation is greater than ±10%. Each bar represents 1% deviation, thus the bargraph covers a range of –10% to +10%.
DEVOUT	The bargraph is configured to display output and/or deviation depending on the lower display. • When the value for setpoint or deviation is in the lower display, the bargraph represents Output. • When the value for other parameters are in the lower display, the bargraph represents deviation.

Monitoring Carbon Potential

DISPLAYS

When monitoring Carbon Potential, the displays will indicate the following:

Upper Display	indicates measured % Carbon (0–2.00%).
Lower Display	shows the current setpoint.

LOWER DISPLAY KEY

Pushing the LOWR DISP key will enable viewing Input 1 - the probe temperature in °C or °F as configured, or the Carbon Probe millivolt signal (0–1250mv).

POTENTIAL SOOTING

If the furnace atmosphere based on carbon potential and temperature exceeds the approximate Austentite boundary and enters the potential sooting region, a "SOOTING" error message will be displayed for 3 seconds, every 10 seconds in the lower display.

Continued on next page

Viewing the operating parameters

Press the LOWR DISP key to scroll through the operating parameters listed in Table 5-4. The lower display will show only those parameters and values that apply to your specific model and the way it was configured.

There is a 60 second time-out if the LOWR DISP key is not pressed.

The LOWR DISP key is also used to return to normal control mode from the Setup mode.

Table 5-4 Lower Display Key Parameter Prompts

LOWER DISPLAY INDICATION (XXXX = Value)	DEFINITION	REMARKS
OUTXXX.X	OUTPUT	Displays the output value* When Position Proportional is installed and in automatic mode, the display represents the motor position. when the controller is configured for 3 Position Step control algorithm and no slidewire exists, it represents the estimated 3 Position Step Motor Position.
2OTXXX.X	OUTPUT #2	Appears only if 2 loop or Cascade is configured
SPXXXX	LOCAL SETPOINT #1	Also current setpoint if using SP Ramp or SP Programming **
2SPXXXX	LOCAL SETPOINT #2	Where RSP does not apply or for 2 loop applications**
RSPXXXX	REMOTE SETPOINT	Optional - when available or setpoint 3***
1INXXXX	INPUT 1	For input combination applications***
2INXXXX	INPUT 2	For input combination applications including Carbon Probe***
3INXXXX	INPUT 3	Optional - mutually exclusive with Position Proportional model***
CSPXXXX	COMPUTER SETPOINT	When SP is in override***
DEVXXXX	DEVIATION	Maximum negative display is –999.9***
PID SET X	TUNING PARAMETER SET 1	Selected set for single or **primary** loop configuration ; X = 1 or 2**
2PID SET X	TUNING PARAMETER SET 2	Selected set for single or **secondary** loop configuration where X = 3 or 4**
XXRAHH.MM	RAMP TIME	Time remaining in the setpoint ramp in hours (HH) and minutes (MM); XX=1 to 19***
XXSKHH.MM	SOAK TIME	Time remaining in the setpoint soak in hours (HH) and minutes (MM); XX=2 to 20***
RECYC X	CYCLES REMAINING	Number of cycles remaining in the setpoint program; X = 0 to 99
RAMPXXXM	SINGLE SETPOINT RAMP TIME	Time remaining in single setpoint ramp in minutes
SAM	SAMPLE NUMBER	Current sample number during Autotune data gathering***
1 PVXXXX	PROCESS VARIABLE 1	Process variable 1 for 2 loop or cascade applications
2 PVXXXX	PROCESS VARIABLE 2	Process variable 2 for 2 loop or cascade applications
POS	MOTOR POSITION	Three Position Step Motor Position when slidewire connected.

* The Output value can be changed in Manual mode only.

** The value can be changed using the [Raise/Lower] keys.

*** The value cannot be changed

Continued on next page

Diagnostic error messages

The UDC5000 performs background tests to verify data and memory integrity. If there is a malfunction, an error message will be displayed.

In the case of more than one simultaneous malfunctions, only the one with the highest priority will appear on the lower display.

A list of error messages is contained in Table 5-5.

If any of these error messages occur, refer to *Section 9 - Troubleshooting* for information to correct the failure.

Table 5-5 Error Messages

Prompt	Description
EE FAIL	Unable to write to non-volatile memory
NV FAIL	Unable to write RAM non-volatile memory
FAILSAFE	Failsafe
INP1FAIL	Two consecutive failures of input 1 integration
INP2FAIL	Two consecutive failures of input 2 integration
INP3FAIL	Two consecutive failures of input 3 integration
INP1 RNG	Input 1 out-of-range
INP2 RNG	Input 2 out-of-range
INP3 RNG	Input 3 out-of-range
SOOTING	Percent Carbon falls above “SOOTING BOUNDARY”
BATT LOW	Battery Voltage is below 2.125Vdc
RH LO	Calculated %RH is below 0%
PV LIMIT	PV ±10% out-of-range PV = INP1 + INP1 Bias Second input algorithm selection (for example: Carbon Potential) does not permit Remote Switching parameter selection of PVIN2 or PVIN3.
RV LIMIT	Remote Variable out-of-range Note: RV =(Input2 x Ratio) +Bias
SEG ERR	Start segment of setpoint program is > than the end segment number.
CONF ERR	• Low limit greater than high limit for PV, SP, Reset, or Output • Conflict between the remote mode switches and the input algorithm selection
SW FAIL	Position Proportioning Feedback Slidewire failure

5.5 Start Up Procedure

Procedure

The Start-up procedure is given in Table 5-6.

Table 5-6 Procedure for Starting Up the Controller

Step	Operation	Press	Action
1	Select manual mode	MAN AUTO	until "MAN" indicator is ON. The controller is in manual mode.
2	Adjust the output	▲ or ▼	to adjust the output value and ensure that the final control element is functioning correctly. Upper Display shows the PV value Lower Display shows OUT and the output value in %.
3	Tune the controller	SET UP	Make sure the controller has been configured properly and all the values and selections have been recorded on the Configuration Record Sheet. To tune your controller manually, see *Appendix A* . Refer to Set Up group 'TUNING" to ensure that the proper selections for PROP BD or GAIN, RATE MIN, and RSET MIN or RSET RPM have been entered. For 2 Loop or Cascade control, refer to "TUNING L2" for tuning parameters. For controllers with ADAPTIVE TUNE or AUTOTUNE, see the procedures in this section.
4	Enter the local setpoint	LOWR DISP	Upper Display shows the PV Value Lower Display SP and the local setpoint value
		▲ or ▼	To adjust the local setpoint to the value at which you want the process variable maintained. The local setpoint cannot be changed if the Setpoint Ramp function is enabled. "H" or "R" appears in the upper display.
5	Select Automatic Mode	MAN AUTO	until "A" indicator is ON. The controller is in Automatic mode. The controller will automatically adjust the output to maintain the process variable at setpoint, if the controller is properly tuned.

5.6 Operating Modes

Available modes

The controller can operate in any of five basic modes:

- Manual
- Automatic with Local Setpoint
- Automatic with Remote Setpoint
- Manual (Cascade)
- Automatic (Cascade)

Manual and Automatic with Local set point are standard features and Automatic with Remote Setpoint is optional.

Mode definitions

Table 5-7 lists the five modes and their definitions.

Table 5-7 Operating Mode Definitions

Operating Mode	Definition
MANUAL	When switched to manual mode, the controller holds its output at the last value used during automatic operation and stops adjusting the output for changes in setpoint or process variable. Instead, you adjust the output by changing the value shown in the lower display. See *"Selecting Manual or Automatic"* in this subsection.
AUTOMATIC with LOCAL SETPOINT	In automatic local mode, the controller will operate from the local setpoint and automatically adjust the output to maintain the setpoint at the desired value. In this mode you can adjust the setpoint. See *Subsection 5.7 - "Setpoints"*.
AUTOMATIC with REMOTE SETPOINT	In automatic remote mode, the controller will operate from the setpoint measured at input 2. Adjustments are available to ratio this input and add a constant bias before it is applied to the control equation. See *Section 3 - Configuration, Set up group "Control"*. *Not available in CASCADE.*
MANUAL (CASCADE)	In the manual cascade mode, both control loops are in manual although there is only one output active. This mode is used to bring both loops into a reasonable operation area, at which point the unit is placed into the Automatic Cascade Mode.
AUTOMATIC (CASCADE)	In Automatic Cascade mode, there are two control loops, with one loop's output acting as the setpoint for the second control loop. There is only one physical output in this mode.

Continued on next page

What happens when you change modes

Table 5-8 explains what happens to the controller when you switch from one mode to another.

Table 5-8 Changing Operating Modes

Mode Change	Description
Manual to Automatic Local Setpoint	The local setpoint is usually the value previously stored as the local setpoint. PV Tracking is a configurable feature which modifies this. When it is selected, the local setpoint value tracks the process variable value continuously while in manual. LSP=PV at the moment you switch from manual to automatic. LSP holds at this one value.
Manual or Auto Local to Automatic Remote SP	The Remote setpoint value with Ratio and Bias applied is used to calculate the control setpoint. Auto Bias is a configurable feature which modifies this. When it is selected, the transfer from automatic local to automatic remote or from manual remote to auto remote adjusts the Bias based on the local setpoint such that Bias = LSP - [IN2 x R].
Automatic Remote SP to Manual or Auto Local Setpoint	If configured for Local Setpoint Tracking, when the UDC transfers out of remote setpoint, the last value of the control setpoint is inserted into the local setpoint. If LSP tracking is not configured, the local setpoint will not be altered when the transfer is made.

Continued on next page

Selecting Manual or Automatic mode

An alternate action switch places the controller in Automatic or Manual mode of operation.

Switching between manual and automatic will be bumpless, except when PD+MR algorithm is selected.

Table 5-9 includes procedures for selecting automatic or manual mode and changing the output while in manual.

Table 5-9 Procedure for Selecting Automatic or Manual Mode

Step	Operation	Press	Action
1	Selecting Automatic Mode	MAN AUTO	until "AUTO" indicator is ON. The controller regulates its output to maintain the PV at the desired setpoint. Upper Display shows the PV value Lower Display shows SP and the setpoint value The deviation bargraph indicates the PV deviation from the setpoint. The annunciators will indicate whichever setpoint is in use: SP Local Setpoint 2SP Second Local Setpoint RSP Remote Setpoint CSP Computer Setpoint
2	Selecting Manual Mode	MAN AUTO	until "MAN" indicator is ON. The controller holds its output at the last value used during automatic operation and stops adjusting the output for changes in setpoint or process variable. Upper Display shows the PV value Lower Display shows OUT and the output value in (%). The bargraph will indicate Deviation or Output whichever is configured.

Table 5-9 continued on next page

Selecting Manual or Automatic mode, continued

Table 5-9 Procedure for Selecting Automatic or Manual Mode, continued

Step	Operation	Press	Action
3	Adjust the Output in Manual Mode	▲ or ▼	to adjust the output value while in manual mode. Upper Display shows the PV value Lower Display shows OUT and the output value in %.
4	Return to Automatic Mode	MAN AUTO	The "A" indicator will appear indicating Automatic mode.

5.7 Setpoints

Introduction

You can configure the following setpoints for the UDC5000 controller.

- A single local setpoint
- 2 local setpoints toggled by the SP1/SP2 key.
- A third local setpoint toggled by the REMSP key.

Selecting the local setpoint source

Use the procedure in Table 5-10 to select a local setpoint source.

Table 5-10 Procedure for Selecting the Local Setpoint Source

Step	Operation	Press	Action
1	Enter Set Up mode	SET UP	until the displays read: Upper Display SET UP Lower Display CONTROL or Upper Display SET UP Lower Display CONTROL2 for Loop 2
2	Display Local Setpoint Source selections	FUNC	until the displays read: Upper Display ← Setpoint source selections 1 ONLY TWO THREE Lower Display LSP 'S
3	Select the desired source	▲ or ▼	to select the desired setpoint source in the upper display.
4	Return to control	LOWR DISP	The controller will assume normal control.

Continued on next page

5.7 Setpoints, Continued

Changing local setpoint 1 or 2 or 3

Use the procedure in Table 5-11 to change either of the local setpoint value.

Table 5-11 Procedure for Changing the Local Setpoints

Step	Operation	Press	Action
1	Select the setpoint	LOWR DISP	until you see Upper Display ☐ ← The PV value Lower Display ☐ ← SP, 2SP, or 3SP and the local setpoint value
2	Change the value	▲ or ▼	to change the local setpoint to the value at which you want the process maintained. SP, 2SP, or 3SP indicator will light to match the lower display.

Continued on next page

Switching between local setpoint 1 and 2

Use the procedure in Table 5-12 to switch between Local Setpoint 1 and 2.

Table 5-12 Procedure for Switching Between Local Setpoint 1 and 2

Step	Operation	Press	Action
1	Select the setpoint	SP1 SP2	to alternately switch between local setpoint 1 and local setpoint 2 (when configured). You will see: Upper Display ☐ ← The PV value Lower Display ☐ ← SP and the local setpoint #1 value, or 2 SP and the local setpoint #2 value
2	Change the value	▲ or ▼	to change the local setpoint to the value at which you want the process maintained. The display "blinks" if you attempt to enter setpoint values beyond the high and low setpoint limits. SP, 2SP, or 3SP indicator will light to match the lower display. **ATTENTION** "KEY ERROR" will appear in the lower display if the 2nd local setpoint is not configured as a setpoint source or if you attempt to change the setpoint while a setpoint ramp is enabled. Setpoint ramp rate will apply to changes between local SP and local SP2, if enabled.

Continued on next page

Switching between local setpoint 3 and local setpoints 1 or 2.

Use the procedure in Table 5-13 to switch between Local Setpoint 3 and Local Setpoint 1 or 2.

Table 5-13 Procedure for Switching Between Local Setpoint 3 and Local Setpoint 1 or 2

Step	Operation	Press	Action
1	Select the setpoint	REM SP	to alternately switch between local setpoint 3 and local setpoint 1 or local setpoint 2 (when configured).
2	Change the value	▲ or ▼	to change the local setpoint to the value at which you want the process maintained. The display "blinks" if you attempt to enter setpoint values beyond the high and low setpoint limits. SP, 2SP, or 3SP indicator will light to match the lower display. **ATTENTION** "KEY ERROR" will appear in the lower display if 3 local setpoints are not configured or remote setpoint is not configured. Setpoint Ramp Rate will apply, if enabled.

Continued on next page

Selecting the remote setpoint source

You can select what you want your remote setpoint to be for each loop:

- None
- Remote setpoint using input 2 toggled by the REMSP key
- Remote setpoint using input 3 toggled by the REMSP key

Use the procedure in Table 5-14 to select the remote setpoint source.

Table 5-14 Procedure for Selecting the Remote Setpoint Source

Step	Operation	Press	Action
1	Select Set Up Group	SET UP	Until you see: Upper Display SET UP Lower Display CONTROL or Upper Display SET UP Lower Display CONTROL2 for Loop 2
2	Select the Remote Setpoint Source Prompt	FUNC	Until you see: Upper Display ◄ The Remote Setpoint source selection NONE - not used IN 2 - Input 2 as RSP IN 3 - Input 3 as RSP Lower Display RSP SRC
3	Change selection	▲ or ▼	to change the remote setpoint source. **ATTENTION** You cannot change the Remote Setpoint Value using these keys.
4	Return to normal operation	LOWR DISP	This will return the controller to normal operation.

Continued on next page

Switching between local and remote setpoints

You can switch between Local and Remote setpoints. Use the procedure in Table 5-15 to switch between setpoints.

Table 5-15 Procedure for Switching Between Local and Remote Setpoints

Step	Operation	Press	Action
1	Select Local setpoint	REM SP	Until you see: Upper Display The PV value Lower Display SP,or 2SP and the local setpoint value
2	Change the Local setpoint value	▲ or ▼	The REMOTE setpoint cannot be changed at the keyboard.
3	Select Remote setpoint	REM SP again	You will see: Upper Display The PV value Lower Display RSP and the remote setpoint value

Continued on next page

Setpoint selection indication

Table 5-16 shows what the displays show for each type of setpoint.

Table 5-16 Setpoint Selection Indication

	Using Local Setpoint	Using Remote Setpoint	Using 2nd Local Setpoint	Using 3rd Local Setpoint
Upper Display	PV	PV	PV	PV
Lower Display	SP and the Local Setpoint Source	RSP and Remote Setpoint Value	2SP and the 2nd Local Setpoint Value	3SP and the 3rd Local Setpoint Value

5.8 Alarm Setpoints

Introduction

An alarm consists of a relay contact and an operator interface indication. When an alarm is in effect, the alarm relay may or may not be energized depending on the configuration of the alarm relay coil in the Alarm Configuration Set Up group, Function prompt "ALM ACTN".

The relay contacts can be configured for normally open (NO)-*energized* or normally closed (NC) *de-energized* by jumper selection. See *Section 2 - Installation* for alarm relay contact information.

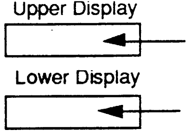
There are four alarm setpoints, two for each alarm.

The type and state (High or Low) is selected during configuration. See *Section 3 - Configuration* for details.

Procedure for displaying the alarm setpoints

The procedure for displaying and changing the alarm setpoints is listed in Table 5-17.

Table 5-17 Procedure for Displaying or Changing the Alarm Setpoints

Step	Operation	Press	Action
1	Access the Alarm Setpoint Values	ALM 1 or ALM 2	to successively display the alarm setpoints and their values. Their order of appearance is shown below. Upper Display The alarm setpoint value Lower Display **For [ALM 1} Key** **A1S1 VAL** = (Alarm 1, Setpoint 1 value) **A1S2 VAL** = (Alarm 1, Setpoint 2 value) **For [ALM 2} Key** **A2S1 VAL** = (Alarm 2, Setpoint 1 value) **A2S2 VAL** = (Alarm 2, Setpoint 2 value)
		▲ or ▼	to change any alarm setpoint value you select in the upper display.
2	Access the Alarm Type or State	ALM 1 or ALM 2	Until you see one of the following prompts in the lower display. **For [ALM 1} key** A1S1 TYPE = (Alarm 1, Setpoint 1 type) A1S2 TYPE = (Alarm 1, Setpoint 2 type) A1S1 H L = (Alarm 1, Setpoint 1 state) A1S2 H L = (Alarm 1, Setpoint 2 state) **For [ALM 2} Key** A2S1 VAL = (Alarm 2, Setpoint 1 value) A2S2 VAL = (Alarm 2, Setpoint 2 value) A1S1 H L = (Alarm 1, Setpoint 1 state) A1S2 H L = (Alarm 1, Setpoint 2 state) Use ▲ or ▼ to change selection.
3	Return to normal operation	LOWR DISP	

5.9 Single Setpoint Ramp

Configuring the setpoint ramp

You can configure a single setpoint ramp to occur between the current local setpoint and a final local setpoint over a time interval of from 1 to 255 minutes. You can RUN or HOLD the ramp at any time.

Procedure

Table 5-18 lists the procedure for configuring the Setpoint Ramp parameters. **For SP Program, see Section 6.**

Table 5-18 Procedure for Configuring a Setpoint Ramp

Step	Operation	Press	Action
1	Select SP RAMP Set Up Group	SET UP	Until you see: Upper Display SET UP Lower Display SP RAMP
2	Select the Setpoint Ramp function	FUNC	Until you see: Upper Display ◄ Enable **–SP Ramp for Loop 1** Enable 2 **–SP Ramp for Loop 2** Enable 12 **–SP Ramp for Loops 1 and 2** Lower Display SP RAMP
3	Enable Setpoint Ramp	▲	to enable the setpoint ramp function. Choose the Loop(s) on which you want the ramp to operate. NOTE: You cannot change the current local setpoint if the setpoint ramp function is enabled.
4	Set the Ramp Time	FUNC	Until you see: Upper Display ◄ The ramp time in minutes Lower Display TIME MIN
		▲ or ▼	to change the upper display value to the number of minutes in which you want the final setpoint to be reached. Setting Range = 0 to 255 minutes NOTE: Entering "0" will imply an immediate step change to the final SP.
5	Set the Final Setpoint value	FUNC	Upper Display ◄ The Final Setpoint value Lower Display FINAL SP
6		▲ or ▼	to change the upper display value to the desired final setpoint value. Setting Range = within the setpoint limits

Running the setpoint ramp

Running a Setpoint Ramp includes starting, holding, viewing the ramp time, ending the ramp and disabling it.

Procedure

Table 5-19 lists the procedure for running the Setpoint Ramp.

Table 5-19 Procedure for Running a Setpoint Ramp

Step	Operation	Press	Action
1	Put the controller into Automatic mode	MAN AUTO	until "AUTO" indicator is ON and you will see: Upper Display H and the PV value Lower Display SP and the present setpoint value
2	Set Start SP	▲ or ▼	until the start setpoint value you desire is indicated in the lower display: Upper Display H and the PV value Lower Display SP and the start setpoint value
3	Start the Ramp	RUN HOLD	you will see: Upper Display R and the PV value Lower Display SP and a changing setpoint value NOTE: The value in the lower display will be increasing or decreasing toward the final setpoint value. The PV value in the upper display will also change.
4	Hold/Run the Ramp	RUN HOLD	To hold the ramp at the current setpoint value. Press again to continue run. A "KEY ERROR" prompt will appear if RUN/HOLD key is pressed while "SP RAMP" is disabled.
5	View the remaining ramp time	LOWR DISP	Until you see: Upper Display R or H and the PV value Lower Display RAMP XXXM (Time remaining)

Table 5-19 continued on next page

Procedure, continued

Table 5-19 Procedure for Running a Setpoint Ramp, continued

Step	Operation	Press	Action
6	Change setpoint during HOLD mode	▲ or ▼	to change the "HELD" setpoint if the ramp is on "HOLD". However, the ramp time remaining is not changed. Therefore, when returning to RUN mode, the setpoint will ramp at the same rate as previous to Local setpoint changes and will stop if the Final setpoint is reached before time expires. If the time expires before the final setpoint is reached, it will jump to the final setpoint.
6	End the Ramp		When the final setpoint is reached, the "R" changes to "H" in the upper display and the controller operates at the new setpoint. **ATTENTION** Anytime the local setpoint is different from the final setpoint value and the RUN/HOLD key is pressed - the ramp will start again.
7	Disable the setpoint ramp function	SET UP	Until you see: Upper Display SET UP Lower Display SP RAMP
		FUNC	You will see: Upper Display ← Enable **–SP Ramp for Loop 1** Enable 2 **–SP Ramp for Loop 2** Enable 12 **–SP Ramp for Loops 1 and 2** Lower Display SP RAMP
		▲	Until you see: Upper Display DISABL Lower Display SP RAMP
8	Return to normal operating mode	LOWR DISP	

5.10 Using Two Set of Tuning Constants

Introduction

You can use two set of tuning constants for single output types and 2 Loop or Cascade control and choose the way they are to be switched. (Does not apply for Duplex Control).
The sets can be:

- Keyboard selected
- Automatically switched when a predetermined Process Variable value is reached.
- Automatically switched when a predetermined Setpoint value is reached.

The following procedures show you how to:

- Select two sets
- Set the switch-over value
- Set tuning constant value for each set
- Switch between two sets via the keyboard (without automatic switch-over)

Select two sets

The procedure in Table 5-20 tells you how to select two sets of tuning constants.

Table 5-20 Procedure for Selecting Two Set of Tuning Constants

Step	Operation	Press	Action
1	Select Control Set Up group	SET UP	Until you see: Upper Display SET UP Lower Display CONTROL or For Loop 2 Upper Display SET UP Lower Display CONTROL2
2	Select PID SETS function	FUNC	Until you see: Upper Display ← Available selections are listed below Lower Display PIdSETS **1 ONLY** - 1 set of constants **2 KEYBD** - 2 sets, keyboard selectable **2 PVSW** - 2 sets, auto switch at PV value **2 SPSW** - 2 sets, auto switch at SP value
		▲or▼	to select the type of PID SET in the upper display.

Continued on next page

Set switch-over value

If you select 2 PVSW or 2 SPSW, you must set a value at which the sets will switch over.
The procedure in Table 5-21 shows you how to set this value.

Table 5-21 Procedure for Setting Switchover Values

Step	Operation	Press	Action
1	Select Switchover value function	FUNC assuming you are still in Set Up group "CONTROL"	Until you see: Upper Display ◄— The switchover value Lower Display SW VALUE
		▲ or ▼	to select the switch-over value in the upper display.

Set Tuning constant values for each set

There are specific tuning constants that must be set for each set. The procedure in Table 5-22 shows you how to access these constants and change their values.

Table 5-22 Procedure for Setting Tuning Constant Values

Step	Operation	Press	Action
1	Select Tuning Set Up Group	SET UP	Until you see: Upper Display SET UP Lower Display TUNING
2	Select the tuning constants	FUNC	to successively display the following constants: Upper Display ◄— The tuning constant value Lower Display ◄— **For Primary Loop** **PROP BD or GAIN*** **RATE*** **RSET*** **PROP BD2 or GAIN2**** **RATE 2**** **RSET2**** **For Loop 2** **PROP BD3 or GAIN3*** **RATE3*** **RSET3*** **PROP BD4 or GAIN4**** **RATE 4**** **RSET4****
		▲ or ▼	To change the value of any of the above listed prompts in the lower display.

*PIDSET1 – will be used when PV or SP, whichever is selected, is greater than the switchover value.
**PIDSET2 – will be used when PV or SP, whichever is selected, is less than the switchover value.

Continued on next page

Switch between two sets via the keyboard (without automatic switch-over)

This procedure is operational only if 2 PID SETS was configured at "CONTROL" set up group.

The procedure in Table 5-23 shows you how to switch from one set to another.

Table 5-23 Procedure for switching PID SETS from the Keyboard

Step	Operation	Press	Action
1	Access the PID set display	LOWR DISP	Until you see: Upper Display The PV value Lower Display PIdSETX **X= 1 or 2**
		▲ or ▼	to change PID SET 1 to PID SET 2 or vice versa. You can Autotune both sets on either loop. See Subsection 5.17

5.11 2 Loops of Control Overview

Introduction

The UDC5000 can operate using Two Independent Loops of control or Internal Cascade control.

TWO INDEPENDENT LOOPS - See Functional Overview Block Diagrams for Loop 1(Figure 5-1) and Loop 2 (Figure 5-2) and Table 5-24 for selections based on these diagrams.

The following rules apply for Two independent loops:

- Current Output on Loop 2 requires Auxiliary output.
- Loop 2 Relay Output is always dedicated to relay 2.
- Loop 2 Current Duplex output is limited to Auxiliary output signal only.
- No Position Proportional or Relay Duplex Outputs on Loop 2.
- No ON/OFF or 3 Position Step algorithm in Loop 2.

INTERNAL CASCADE CONTROL - uses Loop 2 as the primary loop with the output of loop 2 being the remote setpoint of Loop 1.
See Functional Overview Block Diagrams (Figure 5-3) and Table 5-24 for selections based on these diagrams.

The following rules apply for Internal Cascade control:

- Loop 2 must be the primary loop
- Loop 1 must be the secondary (internal or slave) loop because all output forms exist on Loop 1
- Loop 1 remote setpoint is fixed as Loop 2 output.

Selections

Refer to Figures 5-1, 5-2, and 5-3 Block Diagrams and Table 5-24 for selections based on these diagrams.

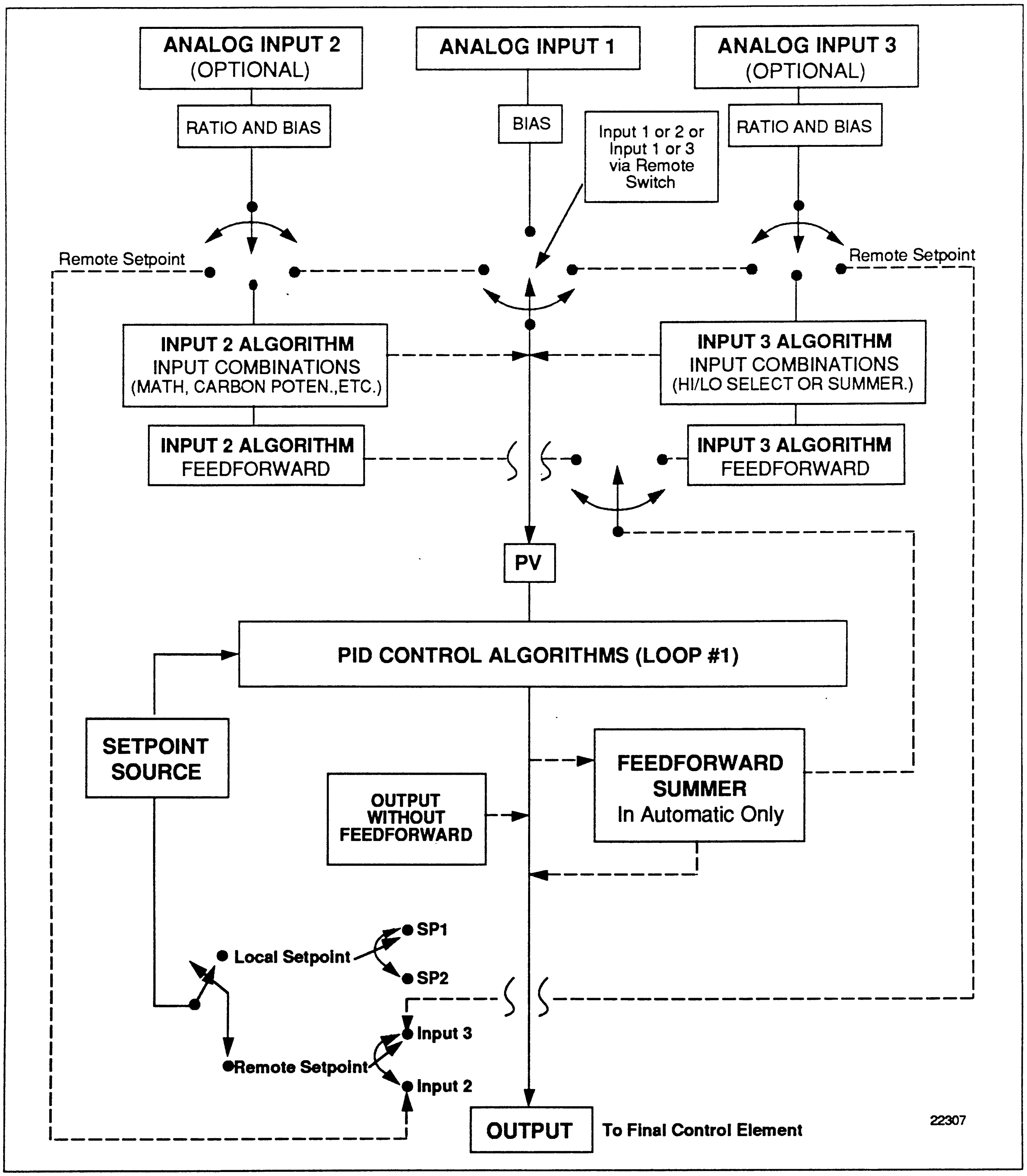
Table 5-24 Selections

LOOP		INPUT 1	INPUT 2	INPUT 3	INPUT 2 ALGORITHM	INPUT 3 ALGORITHM
LOOP 1	Process Variable	Yes	Remote Switching between Inputs 1 and 2	Remote Switching between Inputs 1 and 3	HI/LO Select Summing Carbon Poten Rel Humidity Mult/Div **with Input 1**	HI/LO Select or Summing **with Input 1**
	Remote Setpoint	No	Yes	Yes	No	No
	Feedforward	No	See Input 2 Algorithm	See Input 3 Algorithm	Feed forward 1	Feed forward 1
LOOP 2	Process Variable	Yes via configuration	Via Configuration or Remote Switch 2	Via Configuration or Remote Switch 2	No	No
	Remote Setpoint	No	Yes	Yes	No	No
	Feedforward	No	See Input 2 Algorithm	See Input 3 Algorithm	Feed forward 2	Feed forward 2

Continued on next page

Single Loop Controller Figure 5-2 is is a Block Diagram of a Single Loop Controller - Loop #1.

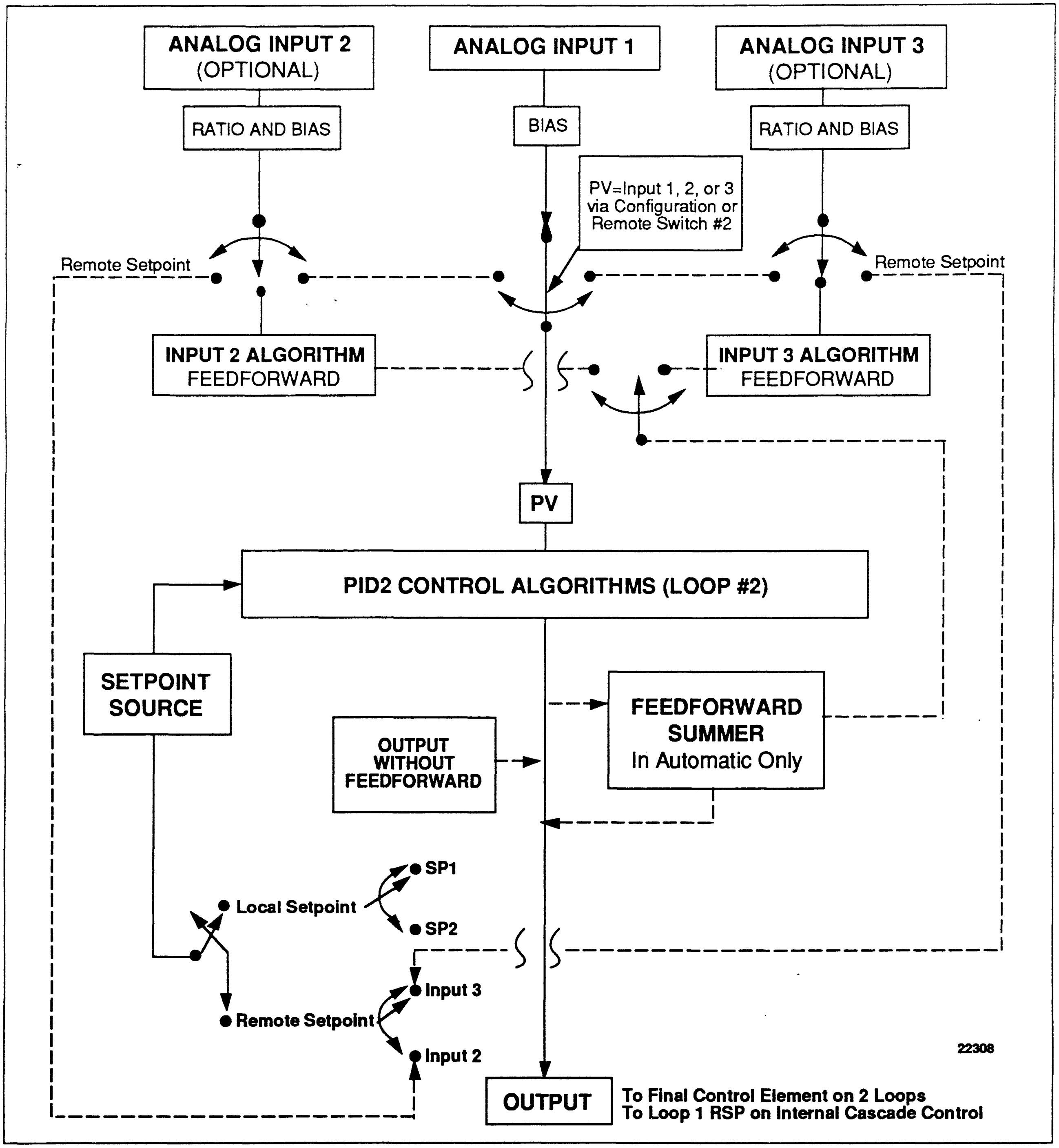
Figure 5-2 Functional Overview Block Diagram of a Single Loop Controller - Loop #1


ANALOG INPUT 2 (OPTIONAL)
ANALOG INPUT 1
ANALOG INPUT 3 (OPTIONAL)
RATIO AND BIAS
BIAS
Input 1 or 2 or Input 1 or 3 via Remote Switch
RATIO AND BIAS
Remote Setpoint
Remote Setpoint
INPUT 2 ALGORITHM INPUT COMBINATIONS (MATH, CARBON POTEN.,ETC.)
INPUT 3 ALGORITHM INPUT COMBINATIONS (HI/LO SELECT OR SUMMER.)
INPUT 2 ALGORITHM FEEDFORWARD
INPUT 3 ALGORITHM FEEDFORWARD
PV
PID CONTROL ALGORITHMS (LOOP #1)
SETPOINT SOURCE
FEEDFORWARD SUMMER In Automatic Only
OUTPUT WITHOUT FEEDFORWARD
Local Setpoint
SP1
SP2
Remote Setpoint
Input 3
Input 2
OUTPUT
To Final Control Element
22307

Continued on next page

Loop 2 Figure 5-3 is is a Block Diagram of a Loop 2 of a 2 Loop controller..

Figure 5-3 Functional Overview Block Diagram of Loop 2 of a 2 Loop Controller

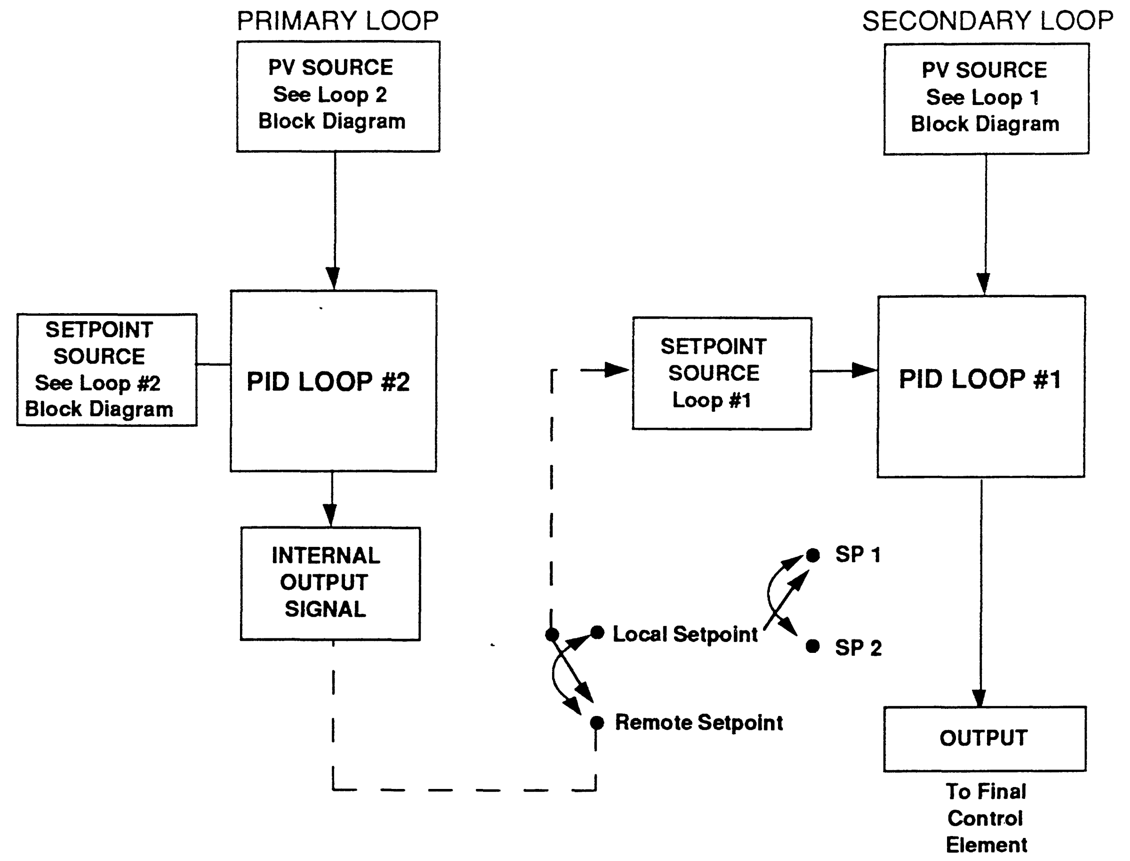

ANALOG INPUT 2 (OPTIONAL)
ANALOG INPUT 1
ANALOG INPUT 3 (OPTIONAL)
RATIO AND BIAS
BIAS
RATIO AND BIAS
PV=Input 1, 2, or 3 via Configuration or Remote Switch #2
Remote Setpoint
Remote Setpoint
INPUT 2 ALGORITHM FEEDFORWARD
INPUT 3 ALGORITHM FEEDFORWARD
PV
PID2 CONTROL ALGORITHMS (LOOP #2)
SETPOINT SOURCE
FEEDFORWARD SUMMER In Automatic Only
OUTPUT WITHOUT FEEDFORWARD
SP1
Local Setpoint
SP2
Input 3
Remote Setpoint
Input 2
22308
OUTPUT
To Final Control Element on 2 Loops
To Loop 1 RSP on Internal Cascade Control

Continued on next page

Internal Cascade

Figure 5-4 is is a Block Diagram of Internal Cascade for a 2 Loop controller.

Figure 5-4 Functional Overview Block Diagram of Internal Cascade of a 2 Loop Controller



INTERNAL CASCADE RULES

- Loop #2 must be the primary loop.
- Loop #1 must be the secondary (internal or slave) loop because all output forms exist on Loop 1.
- Loop #1 Remote Setpoint is fixed as loop #2 output.

22309

Continued on next page

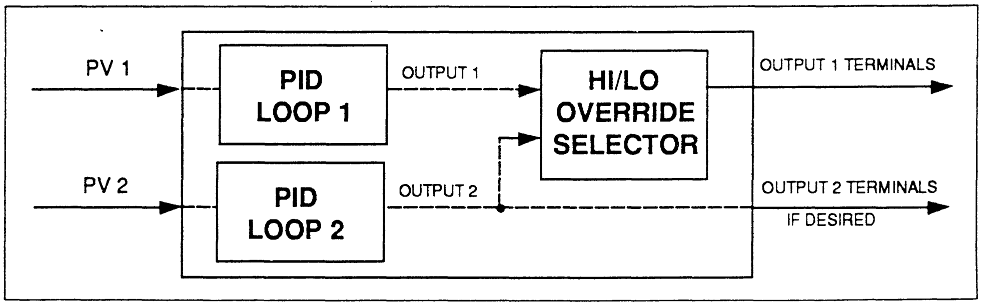
Override rules

The UDC5000 allows you to select high or low output override. Refer to *Section 3 - Configuration* to select High or Low.

The following rules apply for high/low override:
- Only one physical output is required when override is enabled. It is the output from Loop 1 because Loop 2's internal output is routed through the selector.
- Loop 2 output can also be available at all times if desired.
- The unselected output will never change by more than 5% from the selected output (No Windup).

Figure 5-5 is a block diagram of the HI/LO Override Selector.

Figure 5-5 Hi/Lo Override Selector



5.12 Configure 2 Loop of Control

Select 2 loop algorithm

The procedure in Table 5-25 shows you how select the 2 loop algorithm.

Table 5-25 Procedure for Selecting 2 Loop Algorithm

Step	Operation	Press	Action
1	Select Algorithm Set Up Group	SET UP	Until you see: Upper Display SET UP Lower Display ALGORTHM
2	Select the PID Loops	FUNC	to successively display the following constants: Upper Display ◄— 1 LOOP 2LOOPS CASCADE Lower Display ALGORTHM
		▲ or ▼	To select 2 Loops or Cascade.

Select the output algorithm for each loop

See *Subsection 5.11* for rules and regulations then follow the procedure in Table 5-26.

Table 5-26 Procedure for Selecting Output Algorithm for each Loop

Step	Operation	Press	Action
1	Select Output Algorithm Set Up Group	SET UP	Until you see: Upper Display SET UP Lower Display OUT ALG
2	Select Loop 1 Algorithms	FUNC	to successively display the following constants: Upper Display ◄— TIME CURRNT POSITN TIME D CUR D CUR TI TI CUR Lower Display OUT ALG
		▲ or ▼	To select Loop 1 algorithm.

Table 5-5 continued on next page

Select the output algorithm for each loop, continued

Table 5-26 Procedure for Selecting Output Algorithm, continued

Step	Operation	Press	Action
3	Select Loop 2 algorithms	FUNC	Until you see: Upper Display ◄— NONE TIME CURRNT CUR D CUR TI TI CUR Lower Display OUT 2 ALG
		▲ or ▼	To select Loop 2 algorithm.

Select control parameters for each loop

The procedure in Table 5-27 shows you how select the 2 loop algorithm.

Table 5-27 Procedure for Selecting Control Parameters

Step	Operation	Press	Action
1	Select Control Set Up Group	SET UP	Until you see: Upper Display SET UP, Lower Display CONTROL or Upper Display SET UP, Lower Display CONTROL2 For Loop 2
2			Refer to *Subsection 5.11* for rules and restrictions and to *Section 3 - Configuration* to select the individual parameters.

Continued on next page

Select tuning parameters for each group

The procedure in Table 5-28 shows you how select the Tuning Parameters.

Table 5-28 Procedure for Selecting Tuning Parameters

Step	Operation	Press	Action
1	Select Tuning Set Up Group	SET UP	Until you see: Upper Display: SET UP / Lower Display: TUNING or Upper Display: SET UP / Lower Display: TUNING 2 For Loop 2 PID set 1 and 2 (TUNING) are for Loop 1 and single loop applications. PID set 3 and 4 (TUNING2) are for Loop 2 in two loop and cascade control applications.
2	Select Tuning constants	FUNC	to successively display the following constants: Upper Display ◄— The Tuning Constant Value Lower Display ◄— **TUNING CONSTANTS for Primary Loop** **PROP BAND or GAIN** **RATE (MIN)** **RESET (MIN OR RPM)** **CYCLE** **PROP BAND2 or GAIN2** **RATE2 (MIN)** **RESET2 (MIN OR RPM)** **CYCLE2** **OR** **TUNING CONSTANTS for LOOP 2** **PROP BAND3 or GAIN3** **RATE3 (MIN)** **RESET3 (MIN OR RPM)** **CYCLE3** **PROP BAND4 or GAIN4** **RATE4 (MIN)** **RESET4 (MIN OR RPM)** **CYCLE4** Refer to *Section 3 - Configuration* for detailed information. You can Autotune both sets on either loop. Refer to *Subsection 5.17.* Use the FUNC key to switch between loops.
		▲ or ▼	To change the values.

5.13 Monitor 2 Loops of Control

Introduction

Monitoring two individual loops of control or Internal Cascade is the same as a single loop except that **OUT** Indicator **1** and **2** become Loop 1 and Loop 2 indicators when more than one control loop is enabled.

Loop display

Display of Loop 1 or Loop 2 (if configured) is done by toggling the FUNC key.

Viewing each loop's process variable

Regardless of which loop is being displayed "1" or "2", the process variable of the non-displayed loop can be shown in the lower display by repeated presses of the LOWR DISP key until "**1PVXXXX**" or "**2PVXXXX**" is displayed.

Internal cascade indication

When Internal Cascade has been configured, an "I" will appear on the left side of the upper display as long as Loop 1 is operating in the remote setpoint mode (for example: RSP is displayed)

If Local setpoint 1 and 2 is being used, the "I" will disappear until the remote setpoint REM SP key is pushed to switch from local setpoint to remote setpoint.

Switching between automatic and manual modes on either loop will not affect the Internal Cascade indication.

5.14 Operate 2 Loops of Control

Loop operation

Operation of two individual loops of control is identical to operating a single loop of control except that TUNING 2 group applies to Loop 2 only and two PID sets, 3 and 4, are available. TUNING group applies to Loop 1 with PID sets 1 and 2 applicable.

Operating modes and setpoint source

The rules for Auto/Manual modes and changing setpoint sources are the same as single loop operation.

Keyboard operation

Note that the loop being displayed is the only loop affected by normal keyboard operation. However, either loop can be reconfigured when in the Set Up mode regardless of which is being displayed during normal operation.

Autotune

Each loop can be Autotuned, but they must be tuned separately (one at a time). Configure the loop to be enabled and the type of Autotune (automatic or manual step) then follow the normal rules for Autotune.

Adaptive tune

Two independent loops or cascaded loops can be Adaptive tuned at the same time, if configured.

Setpoint Ramp or Setpoint programming

Either loop or both loops can be configured for a single setpoint ramp operation or setpoint programming by enabling the desired loop or loops (see *Section 3 - Configuration*).

An “H” or “R” will appear when applicable, depending upon which loop is being displayed.

The RUN/HOLD operation is shown in Table 5-19 “Running a Single Setpoint Ramp”.

Digital inputs (remote mode switching)

Digital Input Switch 2 is dedicated to Loop 2 and Digital Input Switch 1 is dedicated to Loop 1 when two loops or Cascade control is configured.

Output override Hi/Lo select

Output Override allows you to select the higher of Output 1 and Output 2 (Hi Select) or the lower of Output 1 and Output 2 (Lo Select) to appear at Output 1 terminals to drive the final control element.

Refer to *Subsection 5.11* or Override rules and block diagram.

Override prompts appear under Set Up group “ALGORTHM” and function prompt “OUT OVRD”.

Internal Cascade control

Internal cascade is a function of 2 Loops of control where Loop 2 is the primary loop and the output of Loop 2 is the remote setpoint of Loop1. Refer to Figure 5-4 block diagram.

5.15 Digital Input Option (Remote Switching)

Introduction

The Digital Input option detects the state of external contacts for either of two inputs. On contact closure, the controller will respond according to how each switching input is configured.

If the controller is configured for either Two Loop or Cascade control, then switch #1 operates only on Loop 1 and switch #2 operates only on Loop 2. Make your selection under Set Up group "OPTION", function group prompt "REM SW1" or "REM SW2". See *Section 3 - Configuration* .

Action on closure

Table 5-29 lists the configuration prompt selections, the "Action on Closure", and the display indication for each selection available.

ATTENTION This feature acts as a toggle. If closing contact causes action noted in Table 5-29; reopening contact causes a switch back to the original state or mode.

Table 5-29 Digital Input Option Action on Contact Closure

REMSW1 or REM SW2 selections	Display Indication	Action on contact closure*
To MAN	"MAN" blinks	Puts the controller into manual mode
To SP1	"SP" blinks	Switches out of remote setpoint and selects the local setpoint.
To SP2	"2 SP" blinks	Switches out of first local setpoint and selects the second local setpoint.
To DIR	None	Selects direct controller action.
ToHOLD	"H" blinks	Suspends setpoint ramp or setpoint program.
ToPID2	PID SET2 in lower display	Selects PID2 (transfer if using PID SET 1)
PV IN2	"II IN" blinking	Selects the PV to equal Input 2. (not available for 2Loop, Cascade control, or Carbon Potential Output)
PV IN3	"III IN" blinking	Selects the PV to equal Input 3
To RUN	"R" indicator blinks	Starts a stopped SP Ramp or SP Program.
To BEGN	"R" blinks if in RUN "H" blinks if in HOLD	Resets the SP Program to the setpoint at the beginning of the program without any change in mode or program status.

Keyboard operation

If a particular mode or parameter is selected by the contact closure, using the keyboard to select the same parameter will ensure that the selected mode will be maintained after the remote digital switch is re-opened. The display will blink when the key is pressed; no other indication is made.

5.16 Adaptive Tune(Accutune™)

Introduction

Adaptive Tune will continually adjust the Gain or Proportional Band (P), Rate (I), and Reset Time (D) tuning constants in response to setpoint changes and/or Process Variable disturbances.

Adaptive Tune handles all Local, Remote, and Computer Setpoint changes.

How it works

Adaptive Tune uses a combination of frequency response analysis, time domain analysis, and the rule based expert system techniques to identify the two most dominant process lags plus any dead time.

It then automatically readjusts the PID parameters as necessary. It does this while controlling to setpoint in automatic (closed loop) control mode.

These calculated PID values can be changed, if desired, by disabling Adaptive Tune and entering different values.

Tuning can be aborted by pushing Man/Auto key to return to manual mode.

Setpoint changes

During start-up, or whenever the setpoint changes, Adaptive Tune employs time domain analysis to tune the process at any desired setpoint without any prior initialization or process knowledge.

Process variable disturbances

During Process Variable (PV) disturbances which result from non-linearities, process dynamics, load changes or other operating conditions. Adaptive Tune uses frequency response analysis techniques to continually respond to PV disturbances as small as 0.3%.

Rules and regulations

The following is a list of rules and regulations for Adaptive Tune. Adaptive Tune:

- can tune on all Local, Remote or Computer setpoints
- will work only for algorithms PID-A or PID-B selections
- is done in automatic mode
- can operate during setpoint ramp or setpoint programming
- can be monitored or reconfigured over Honeywell's communication network
- can be disabled via Remote Switching Inputs
- can tune two independent loops or cascaded loops at the same time
- does not bump the output during operation
- cannot be used with 3 position step
- When a setpoint Adaptive Tune is in progress, a large "T" appears in the upper display. During this time, no changes to the configuration parameters, including the setpoint, are permitted.

Continued on next page

5.16 Adaptive Tune (Accutune™), Continued

Configuration

Before starting Adaptive Tune you must

- enable the Adaptive Tune feature
- select whether you want to adaptive tune on setpoint changes only or both setpoint and PV changes.
- set the minimum value of setpoint change in % of span that will result in re-tuning.

Procedure

Use the procedure in Table 5-30 to configure these items.

Table 5-30 Procedure for Configuring Adaptive Tune Parameters

Step	Operation	Press	Action
1	Select Autotune Set Up Group	SET UP	Until you see: Upper Display SET UP Lower Display AUTOTUNE
2	Select Adaptive Tune	FUNC	you will see either: Upper Display ← ADAPT - Adaptive Tuning or A TUNE - Autotune Lower Display TUNETYPE
		▲ or ▼	until ADAPT appears in the upper display.
3	Select the type of Adaptive Tune for Loop 1	FUNC	You will see: Upper Display ← **DISABLE,** **SP ONLY** **SP + PV** Lower Display ADAPTUNE **DISABLE** - Adaptive Tune disabled **SP ONLY** - Adaptive Tune will occur on setpoint changes only **SP + PV** - Adaptive Tune will occur on Setpoint changes and also when there is a Process Variable disturbance of greater than 0.3% of span.
		▲ or ▼	until the desired selection appears in the upper display.

Table 5-30 continued on next page

Configuration, continued

Table 5-30 Procedure for Configuring Adaptive Tune Parameters, continued

Step	Operation	Press	Action
4	Enter the setpoint change value for **Loop 1**	FUNC	until you see Upper Display **Range: ±5 to 15% of PV Span** Lower Display SP CHANG This is the minimum setpoint change value on which re-tuning will occur. Example: If the range is 0 to 2000, and 5% is configured here, re-tuning will occur if the setpoint change is 100 or larger.
		▲ or ▼	until the desired range appears in the upper display.
5	Verify or change the process Gain value for **Loop 1**	FUNC	You will see: Upper Display **Range: 0.01 to 50.00** Lower Display K P G The Process Gain Value is normally a READ only value. It should only be changed if the controller fails to identify the process. In this case, set the value to the algebraic value of PV in percent, divided by output in percent, as displayed while in manual mode.
		▲ or ▼	until the desired range appears in the upper display.
If Loop 2 is configured: The procedure is the same as listed for Loop 1 except the prompts will be: ADAPT 2 SPCHANGE2 K P G 2			

Continued on next page

Start-up mode

At start-up, SP ADAPT tuning is used. The procedure for start-up is listed in Table 5-31.

Table 5-31 Procedure for Using Adaptive Tune at Start-up

Step	Operation	Press	Action
1	Put the controller into manual mode	MAN AUTO	Until the MAN indicator is ON. You will see: Upper Display ◄— the PV value Lower Display OUT XXX.X
		▲ or ▼	to adjust the output value in the lower display, so that the PV lines out at least 10% of PV range and much lower than the normal setpoint setting.
2	Let PV stabilize		Allow the PV to stabilize (stop changing). Depending on the response time of the process, you may have to wait a while for the PV value to line out. Watch the displays for a stable condition.
3	Adjust the setpoint	LOWR DISP	Until you see: Upper Display ◄— the PV value Lower Display SP XXXX
		▲ or ▼	to adjust the setpoint value in the lower display to the desired setpoint at which you plan to operate after Adaptive Tune is completed.
4	Start SP ADAPT tuning	AUTO TUNE	The controller will switch to automatic mode and the process will start to move toward the setpoint and will line out with the proper tuning constants. A large "T" appears on the left side of the upper display to indicate that (SP ADAPT) Adaptive tune is in progress. You will see: Upper Display T XXXX ◄— the PV value Lower Display SP XXXX ◄— the setpoint value If you switch to automatic [MAN/AUTO key] instead of pressing the [AUTOTUNE] key, "PV ADAPT" will occur (if the PV is different than the setpoint) but it will take longer than SP ADAPT especially if the process is slow.

Table 5-31 continued on next page

5.16 Adaptive Tune (Accutune™), Continued

SP ADAPT (after Start-up)

SP ADAPT will occur whenever the controller is in automatic mode and a setpoint change occurs which is greater than the previously configured minimum setpoint change value.

The controller will delay using any setpoint changes for 30 seconds to enable it to calculate whether to "SP ADAPT" or not. But, if the controller is toggled between LSP1 and LSP2 or if any other key (such as LOWR/DISP) is pressed, the setpoint change is immediate.

A large "T" is displayed in the upper display whenever SP ADAPT mode is in progress. During this time, no changes to the configuration parameters, including the setpoint, are permitted.

SP+PV Adapt

PV ADAPT will occur whenever a PV disturbance of 0.3% span or larger occurs. It will take 1 and 1/2 process cycles around the setpoint before any process recognition can occur.

A small "T" is displayed in the upper display whenever PV ADAPT mode is in progress. During this time, changes to the configuration parameters are permitted. However, this may cause the PV adapt process to abort.

Aborting Adaptive Tuning

If it is necessary to stop or abort the tuning, press the Man/Auto key to return to Manual mode. This will cause an immediate abort of tuning.

Also, Adaptive Tune can be temporarily disabled by properly configuring a digital input.

Continued on next page

5.16 Adaptive Tune (Accutune™), Continued

Re-Tuning

The controller will evaluate current tuning as SP and PV changes occur. When re-tuning is required, the controller operates in automatic mode controlling to new "intermediate" tuning constants until PV lines out within approximately 0.2% span of SP.

At that point, the "T" disappears and "Final" tuning values are entered and used until re-tuning occurs again. The controller never goes into manual and does not bump the output to evaluate tuning requirements.

Note that if re-tuning was not required, no changes will be made; but, the "T" will still occur to indicate that Adaptive Tune algorithm is measuring the process response.

Error code accessing procedure

When an error is detected in the Adaptive tune process, the message "AT ABORT" will appear in the lower display.

Access function prompt "AT ERROR" to determine what is causing the error. This procedure is listed in Table 5-32.

Table 5-32 Procedure for Accessing Adaptive Tune Error Codes

Step	Operation	Press	Action
1	Select Adaptive Tune Set Up Group	SET UP	Until you see: Upper Display SET UP Lower Display ADAPTIVE
2	Go to Error Code prompt	FUNC	You will see: Upper Display ← An error code Lower Display AT ERROR Table 5-33 lists all the Adaptive tune error codes and their definitions and what action to take to correct the error.

Continued on next page

Error codes Table 5-33 lists the Adaptive Tune error codes and their definitions.

Table 5-33 Adaptive Tune Error Code Definitions

Upper Display Prompt	Code Definition	Action to Take
NONE	NO ERRORS	None
OUTLIMIT	SP Adapt step is greater than high output limit or less than low output limit	• Check the output limits under Set Up group prompt "CONTROL", function prompts "OUTHILIM" and "OUTLOLIM" in *Section 3 - Configuration*. • Check "PROCESS GAIN" (KPG). Refer to Table 5-30.
IDFAIL	Process Identification Failure	Try to SP Adapt again.
ABORT	• Manual abort has occured – Adaptive tune will abort if the MAN/AUTO key is pressed during tuning • Automatic Abort has occured – Adaptive tune will automatically abort when a pV oscillation has been detected during "SP ADAPT", whenever any SP values are changed during a "PV ADAPT", or when Adaptive Tune is disabled.	Try to SP Adapt again.
LOW PV	Occurs during a SP ADAPT when the output step calculated is too low to produce a PV value close to the desired setpoint.	NONE - After a period of about 5 minutes, the "SPADAPT" will be retried automatically with a larger output step.
RUNNING	Informal prompt indicating that "SP ADAPT" is still active checking process gain even though "T" is not lit. It does not affect the keyboard operation.	None

5.17 Autotune

Introduction

Autotune automatically calculates Gain (PB), Rate (Derivative), and Reset (Integral) Time tuning constants **on demand**. These tuning constants are calculated at the end of the Autotune procedure based on the output step introduced onto the process.

How it works

An output step causing an approximately 4.0% change in PV will be automatically generated when Autotune is performed using the Auto step approach. If you select the manual step approach, you must select a specific output step size in % that will be large enough to result in at least a 2.5% PV change. These constants, once calculated, are automatically entered into the controller memory in their normal locations.

Slow or fast response

Autotune provides the theoretical PID constants which results in little or no overshoot. This usually provides a conservative Gain value which results in a slower response to insure no overshoot. If faster response is desired and some overshoot can be tolerated, the calculated Gain value can be increased by a factor of 2 or perhaps more or PB decreased by a factor of 2. Of course, the process loop must be checked for stability in the automatic mode.

Autotune Alarm

Alarm 1 is available to protect the process during Autotune. If alarm set point is exceeded during the sampling period Autotune will abort. This eliminates the need to continually monitor the Autotune sequence.

Where to operate Autotune

Autotune is most effective when implemented in the region of PV where you plan to operate. Don't Autotune at 900°F if you plan to operate at 1300°F. The process dynamics may be different at different energy levels. Always try to start Autotune 2.5% below your operating setpoint.

Short Tune feature

There is a SHORT TUNE feature that lets you obtain approximate tuning constants by prematurely implementing the Autotune calculation before the PV has fully lined out during the Autotune process.

Summary

In summary, Autotune and Short Tune can be used as a flexible tool to quickly identify Gain, Rate, and Reset time constants. Further tuning can be done using these values as a starting point.

IMPORTANT: Autotune will function only when the controller is in a closed loop system. Attempts to Autotune open loop will result in "ABORT" error message.

Continued on next page

Summary, continued

ATTENTION

- Set Point Ramp and Set Point Programming cannot be enabled while Autotune is in operation.
- Autotune can be applied to 3 Position Step Control.
- A STEP may be performed in automatic mode.
- M STEP must be in manual mode.

FOR 2 LOOP INTERNAL CASCADE

- On a 2 loop controller, each loop must be separately autotuned. Initiate the procedure for each loop.
- On Internal Cascade, first tune the second loop of control (Loop 1).

Configuration

Before starting Autotune you must

- enable the Autotune feature, make sure the AUTOTUNE key is not locked out.
- select whether you want the controller to generate an output step automatically (ASTP) or whether you want to enter an output step size manually (MSTP).
- set Alarm 1 Set Point 1 to proper type and value to protect process if desired -- otherwise set to NONE to avoid accidental abort.
- select the set point at which you want it to line-out after Autotune.

Procedure

Use the procedure in Table 5-34 to configure the Autotune parameters.

Table 5-34 Procedure for Configuring Autotune Parameters

Step	Operation	Press	Action
1	Select Autotune Set Up Group	SET UP	Until you see: Upper Display SET UP Lower Display AUTOTUNE
2	Select Tune Type	FUNC	You will see: Upper Display ← ADAPT - Adaptive Tuning or A TUNE - Autotune Lower Display TUNETYPE
		▲ or ▼	until A TUNE appears in the upper display.

Table 5-34 is continued on next page

Procedure, Continued

Table 5-34 Procedure for Configuring Autotune Parameters, Continued

Step	Operation	Press	Action
3	Select output step type	FUNC	You will see: Upper Display dIS Lower Display AT ENb
		▲ or ▼	to select "ASTEP or MSTEP" in the upper display Upper Display ← **DISABL** **ASTEP-** (will generate the output step automatically) **MSTEP**- (requires you to manually enter a step size value under prompt "OUTSTP.") **ASTEP2-** (same as A STEP except cascade primary [loop2] or second control loop) **MSTEP2**- (same as MSTEP except cascade primary [loop2] or second control loop) Lower Display AT ENABL If you select MSTEP go to step 4 if you select ATSTEP go to step 5.
4	Select Output Step Size for MSTEP	FUNC	You will see: Upper Display ← The value of the controller output step size in % Lower Display OUTSTP Range of setting: -100 to 100% of output
		▲ or ▼	to choose an output step in percent that will be applied to the output of the controller when Autotune is initiated. This step must be large enough to result in a PV change of at least 2.5% of span. Use as large a step as possible. ATTENTION The process can be tuned using either an upscale or downscale step change.
5	Exit Configuration mode	LOWR DISP	once to exit Configuration mode.

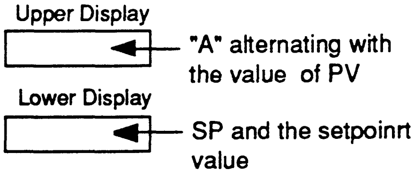
Continued on next page

Starting Autotune

How you ready the controller to start Autotune depends on what type step change you have selected

- ASTP (automatic step change)
  - let the controller PV line out (PV = SP)
- MSTP (manual step change)
  - make sure you have selected an output step change value that will result in a PV change of at least 2.5% (See OUTSTP" on previous page)
  - let the controller PV line out (PV = SP)
- Use the procedure in Table 5-35 to start Autotune.

Table 5-35 Starting Autotune

Step	Operation	Press	Action
1	Start Autotune	AUTO TUNE	The Autotune algorithm automatically introduces the output step change (Manual - MSTP or Automatic - ASTP) onto the process. "TUNE" appears in the upper display to indicate that the Autotune is in progress. You will see:  Upper Display "A" alternating with the value of PV Lower Display SP and the setpoinrt value

ATTENTION The output value upon which the output step is based is not the instantaneously displayed output value, but an internal averaged value of the output.

Reasons for Abort

The algorithm samples the step response of the process until that response has lined out. The line out time depends on the process reaction time.

- if no line-out has occurred after 48.54 hours of sampling
- in "Auto Step", if the resultant PV step is less than 2.5%.

Viewing the Remaining Samples

You can view the remaining number of samples left in the most recently initiated time window. (See "STEP RESPONSE SAMPLING") on the next page.

Press the LOWR DISP key until you see "SAM" and the number of samples counting down in the current time window in the lower display.

Continued on next page

Step Response Sampling

When Autotune is initiated, the controller output is step changed. The algorithm samples the step response of the process until the response has lined out (PV stabilized). The line-out time depends on the process reaction time.

Time Window

A time window is the time it takes for the algorithm to sample the step response of the process for line-out. The first time window takes 256 PV samples at the rate of one every 1/3 second. The lower display counts down from 256 until it reaches 0 (total time elapsed = 85-1/3 seconds) at which time the algorithm checks for the line-out. If the line-out has not occurred, another time window takes 128 samples at a rate of one every 2/3 second. The lower display counts down from 128 until it reaches 0 (total time elapsed for two windows = 170-2/3 seconds) and again checks for line-out. If there is no line-out, a third window of 128 samples, at 1-1/3 seconds each, is initiated. As long as there is no line-out, this time windowing will continue 9 more times, each time sampling at a lower rate. See Table 5-36 to determine what time window the controller is displaying. By determining how long one sample takes (column C in Table 5-36), you can find out what time window the controller is displaying (column A) and how long the time window will last (column D).

Example

If one sample takes 42-2/3 seconds then the Autotune algorithm is in the #8 time window and will take 91 minutes to complete. At the end of window #8 the total time elapsed for all windows is 3.03 hours. If the line-out has not occurred after the 12th window (48.54 hours) the Autotune will abort.

Time Window Samples

Table 5-36 lists the window number, number of samples, sampling time, window time and total time window.

Table 5-36 Time Windows

A	B	C	D	E
Window Number	**Total Samples***	**Sampling Time**	**Time for This Window**	**Total Time Window**
1	256	1/3 sec	85-11/3 sec	85-1/3 sec
2	128	2/3 sec	85-1/3 sec	170-2/3
3	128	1-1/3 sec	170-2/3 sec	341-1/3 sec
4	128	2-2/3	341-2/3 sec	11-1/4 min
5	128	5-1/3	11-1/4 min	22.7 min
6	128	10-1/3 sec	22.7 min	45.5 min
7	128	21-1/3	45.5 min	91.0 min
8	128	42-2/3 sec	91.0 min	3.03 hrs
9	128	85-1/3 sec	3.03 hrs	6.07 hrs
10	128	170-2/3 sec	6.07 hrs	12.14 hrs
11	128	341-1/3 sec	12.14 hrs	24.27 hrs
12	128	682-2/3 sec	24.27 hrs	48.54 hrs

*** The lower display indicates the number of samples remaining in the present window number.**

"SHORT TUNE" feature

This feature lets you obtain approximate tuning constants by prematurely implementing the Autotune calculation before the PV has fully lined-out during the Autotune process. This typically results in a different Gain value, however, Rate and Reset time will be relatively close to the optimally calculated value. You can then increase gain by a factor of 2 to 4 until an acceptable stable closed loop response is achieved -- all in a short time -- without prior process knowledge or trial and error guesswork.

Implementing Short Tune

After implementing the Autotune process, press the AUTOTUNE key while the controller is sampling the process response. "A" in the upper display will start to blink acknowledging the short tune procedure.
At the end of the time window (when lower display SAM = 0), the Autotune algorithm calculates constants based on the PV response up to that time, if the PV has changed by at least 2.5% of span.

Error code accessing procedure

When an error is detected in the Autotune process, the message "ABORT" appears in the lower display.
Access function prompt "AT ERROR" to determine what is causing the error. This procedure is listed in Table 5-37.

Table 5-37 Procedure for Accessing Autotune Error Codes

Step	Operation	Press	Action
1	Select Autotune Set Up Group	SET UP	Until you see: Upper Display SET UP Lower Display AUTOTUNE
2	Go to Error Code Prompt	FUNC	You will see: Upper Display ◄— An error code Lower Display AT ERROR Table 5-38 lists all the Autotune error codes, their definitions, and how to correct the problem.

Continued on next page

Error Codes Table 5-38 lists the Autotune error codes, their definitions, and what to do about the error.

Table 5-38 AUTOTUNE Error Code Definitions

Error Code (Upper Display)	Definition	Action to Take
OUTLIM	OUTPUT GREATER THAN HIGH OUTPUT LIMIT OR LESS THAN LOW OUTPUT LIMIT	• Check the output limits under "CONTROL" function prompts "OUTHILIM" and "OUTLOLIM." See *Section 3 - Configuration.* • If you are using a manual step change, reconfigure "OUTSTEP" prompt under AUTOTUNE group. • Restart Autotune procedure.
DUPLIM	OUTPUT GREATER OR LESS THAN THE HEAT/COOL LIMITS The step entered cool zone when tuning heat, or the step entered heat zone when tuning cool.	• Reconfigure the step size to fall only within heat or cool zone. Autotune function prompt "OUTSTEP." • Restart Autotune procedure.
ALARM 1	ALARM 1 LIMIT EXCEEDED Alarm 1 error code will show if you have configured alarm 1 to activate at a value of a parameter and it is exceeded.	• Check alarm type and limit under "ALARM" function prompts "A1S1VAL" and "A1S1TYPE." • Reconfigure smaller step size. • Restart Autotune procedure.
LOW PV	PV CHANGE NOT GREATER THAN 2.5% The algorithm has sampled the process step response for a period of time (48 hours max.) and the PV has lined out with less than a 2.5% change.	• Reconfigure to MSTEP and use a larger step size "AUTOTUNE" function prompt "OUTSTEP." • Restart Autotune procedure.
IDFAIL	PROCESS IDENTIFICATION FAILURE Autotune has aborted due to either excessive noise or a step response interruption, or because the process cannot be tuned.	• Excessive noise - reconfigure larger step size "AUTOTUNE" function prompt "OUTSTEP." • Step response interruption - make sure interruption is not repeated. - restart Autotune procedure. • Untunable process -- contact local application engineer.
_I_LIM	RESET LIMITS EXCEEDED The reset value has exceeded high or low limits. The unit will control at high or low limits. Low = 0.02 minutes High = 50.0 minutes	• Increase or decrease PB or Gain to bring reset within the defined limits. • Check the final control element for proper application. • Untunable process -- contact local application engineer.

Table 5-38 is continued on next page

Table 5-38 AUTOTUNE Error Code Definitions, Continued

Error Code (Upper Display)	Definition	Action to Take
_P_LIM	GAIN LIMITS EXCEEDED The Gain value has exceeded high or low limits . The unit will control at high or low limits, Low = 0.1 High = 999.9	• Increase or decrease Reset to bring Gain or PB to within defined limits. • Check the final control element for proper application. • Untunable process -- contact local application engineer.
ABORT	MANUAL ABORT Autotune has been manually aborted.	• Autotune will abort if the MAN/AUTO key is pressed during Autotune.
INPUT	INPUT ERROR An input is outside of its 0 to 100 % range, or any input failed.	• Make sure the range and actuation are configured properly. • Check the input source(s).
RAMP	AUTOTUNE ILLEGAL DURING RAMP OR SET POINT PROGRAM.	• Wait until Ramp or program is complete and restart Autotune.
RMSW	AUTOTUNE IS ABORTED WHEN EXTERNAL SWITCH IS DETECTED	• Restart Autotune -- Do not interrupt with digital input (Remote Switching) contact closure.

Aborting Autotune

To abort Autotune and return to the last previous operation (SP or output level), press MAN/AUTO key to abort the Autotune process.

- Autotune will automatically abort if alarm and setpoint are exceeded or if the Autotune procedure requires more than 12 windows.

Completing Autotune

When Autotune is complete -

- the calculated tuning parameters are stored in their proper memory location in the controller, and
- the controller will control at the local setpoint using the newly calculated tuning constants.

Section 6 – Setpoint Ramp/Soak Programming Option

6.1 Overview

What is programming?

The term "programming" is used here to identify the process for selecting and entering the individual ramp and soak segment data needed to generate the required setpoint versus time profile (also called a program).

A segment is a ramp or soak function which together make up a setpoint program. Setpoint Ramp/Soak Programming lets you configure 10 ramp and 10 soak segments to be stored for use as one program or several small programs. You designate the beginning and end segments to determine where the program is to start and stop.

Review program data and configuration

While the procedure for programming is straightforward, and aided by prompts, we suggest that you read *"Program Contents"* in this section as well as *"Section 4 - Configuration Prompt Definitions"* before doing the setpoint programming.

Fill out the worksheet

Draw a Ramp/Soak Profile on the worksheet provided and fill in the information for each segment. This will give you a record of how the program was developed.

What's in this section

The table below lists the topics that are covered in this section.

Topic		See Page
6.1	Overview	179
6.2	Program Contents	180
6.3	Drawing a Ramp/Soak Profile	182
6.4	Entering the Setpoint Program Data	186
6.5	Run/Monitor the Program	190

6.2 Program Contents

What you will configure

Basically, you will configure all the data that is relevant to each ramp and soak segment for a given setpoint versus time profile. The controller will prompt you through the sequence of segments and associated functions.

Ramp segments

A ramp segment is the time it will take to change the setpoint to the next setpoint value in the program.

Ramps are odd number segments. Segment #1 will be the initial ramp time.

Ramp time is determined in either:

TIME* - Hours:Minutes Range = 0-99hrs:59 min.

or

RATE* - Degrees/Minute Range = 0 to 999

* This selection of time or rate is made at prompt "RAMP UNIT"

Set this prompt before entering any Ramp.

ATTENTION Entering "0" will imply an immediate step change in setpoint to the next soak.

Soak segments

A soak segment is a combination of a soak setpoint (value) and a soak duration (time).

Soaks are even number segments.

Segment 2 will be the initial soak value and soak time.

The soak setpoint range value must be within the setpoint high and low range limits in engineering units.

SOAK TIME is the duration of the soak and is determined in:

TIME - Hours:Minutes RANGE = 0-99hrs:59 min.

Start segment number

This designates the number of the first segment.
Range = 1 to 19

End segment number

This designates the number of the last segment. It must be a soak segment (even number).
Range = 2 to 20

Recycle number

This number allows the program to recycle a specified number of times from beginning to end.
Range = 0 to 99

Continued on next page

Guaranteed Soak

Each soak segment can have a deviation value of from 0 to ±99 which guarantees the value for that segment.

Guaranteed soak segment values >0 guarantee that the segments process variable is within the ± deviation for the configured soak time. Whenever the ± deviation is exceeded, soak timing is frozen.

There are no guaranteed soaks whenever the deviation value is configured to 0, i.e., soak segments start timing soak duration as soon as the soak setpoint is first reached, regardless of where the process variable remains relative to the soak segment.

The value is the number in engineering units, above or below the setpoint, outside of which the timer halts. The range is 0 to ± 99.

The decimal location corresponds to input 1 decimal selection.

Program state

This selection determines the program state after completion.

The selections are:

DISABL = Program is disabled
HOLD = Program on hold (RUN key restarts the program)

Program termination state

This function determines the status of the controller upon completion.

The selections are:

LAST SP = controls to last setpoint and last control mode
F SAFE = Manual mode, Failsafe Output

ATTENTION If power is lost during a program, upon power-up the controller will be in hold and the setpoint value will be the setpoint value prior to the beginning of the setpoint program. The program is placed in hold at the beginning of the first segment in the program.

Ramp unit

This determines the engineering units for the ramp segments.

The selections are:

TIME = Hours:Minutes
RATE = Degrees/Minutes

ATTENTION This selection cannot be changed while a program is in operation.

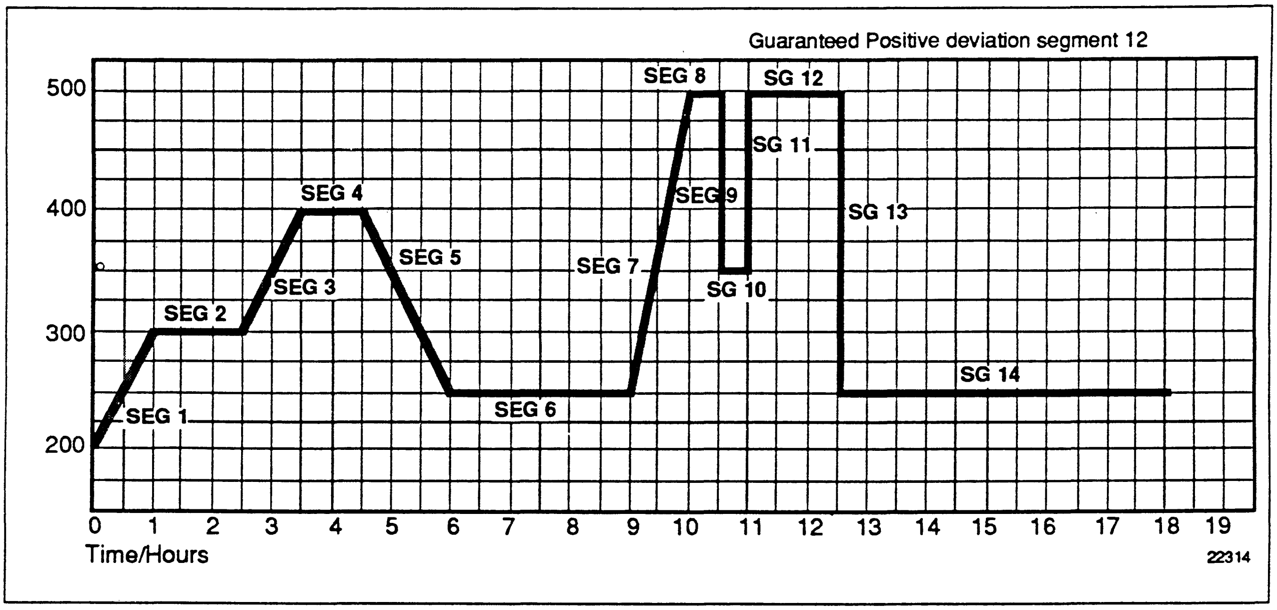
6.3 Drawing a Ramp/Soak Profile

Ramp/Soak Profile example

Before you do the actual configuration, we recommend that you draw a Ramp/Soak profile in the space provided on the "*Program Record Sheet*" (Figure 6-2) and fill in the associated information.

An example of a Ramp/Soak Profile is shown in Figure 6-1.

Figure 6-1 Ramp/Soak Profile Example



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6.3 Drawing a Ramp/Soak Profile, Continued

Ramp/Soak Profile example, continued

Figure 6-1 Ramp/Soak Profile Example, continued

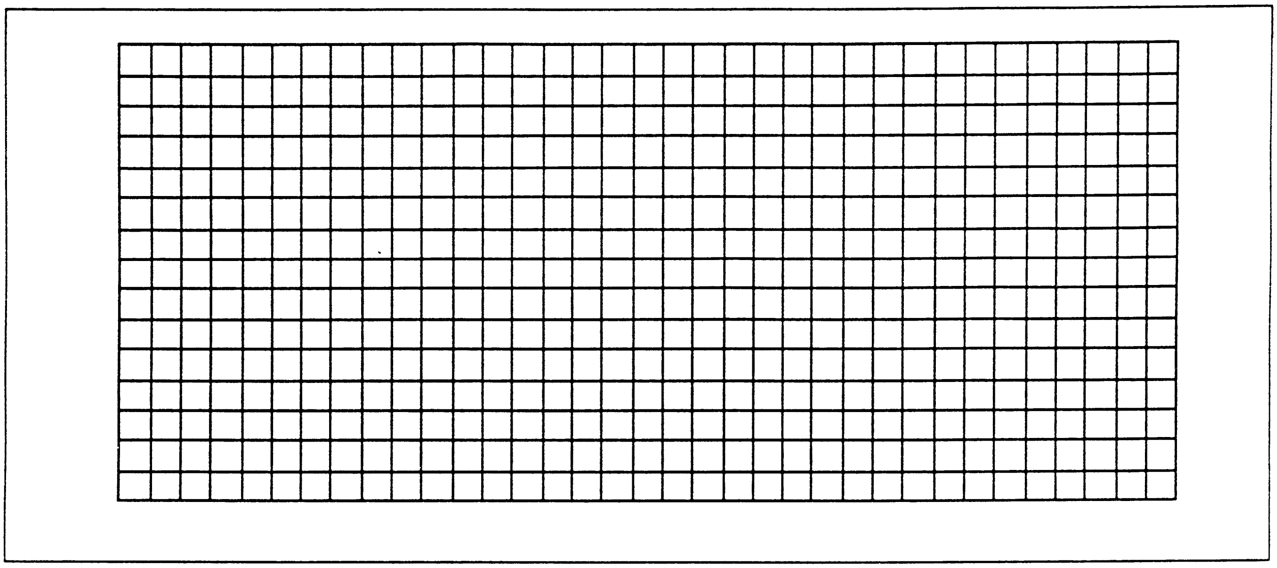
Prompt	Function	Segment	Value
STRT SEG	Start Seg.		1
END SEG	End Seg.		14
RECYCLES	Number of Recycles		2
SEG1RAMP	Ramp Time	1	1 hr.
SEG2 SP	Soak SP	2	300
SEG2TIME	Soak Time	2	1hr.:30 min.
SEG3RAMP	Ramp Time	3	1hr.
SEG4 SP	Soak SP	4	400
SEG4TIME	Soak Time	4	1 hr.
SEG5RAMP	Ramp Time	5	1hr.:30 min.
SEG6 SP	Soak SP	6	250
SEG6TIME	Soak Time	6	3hrs.:0min.
SEG7RAMP	Ramp Time	7	1 hr.
SEG8 SP	Soak SP	8	500
SEG8TIME	Soak Time	8	0hr.:30 min.
SEG9RAMP	Ramp Time	9	0
SG10 SP	Soak SP	10	350
SG10 TIME	Soak Time	10	0hr.:30 min.
SG11RAMP	Ramp Time	11	0
SG12 SP	Soak SP	12	500
SG12TIME	Soak Time	12	1hr.:30 min.
SG13RAMP	Ramp Time	13	0
SG14 SP	Soak SP	14	250
SG14TIME	Soak Time	14	5hr.:30 min.
SG15RAMP	Ramp Time	15	
SG16SP	Soak SP	16	
SG16TIME	Soak Time	16	
SG17RAMP	Ramp Time	17	
SG18 SP	Soak SP	18	
SG18 TIME	Soak Time	18	
SG19RAMP	Ramp Time	19	
SG20SP	Soak SP	20	
SG20 TIME	Soak Time	20	
GUAR SOAK	Guaranteed Soak Deviation	SKDEV + 12	5
PROG END	Controller Status		LAST SP
STATE	Controller State at end		HOLD
POWER UP	Power Outage		RESUME
RAMP UNIT	Engr. Unit for Ramp		TIME

Continued on next page

Program Record Sheet

Draw your ramp/soak profile on the record sheet shown in Figure 6-2 and fill in the associated information in the blocks provided on the next page. This will give you a permanent record of your program and will assist you when entering the Setpoint data.

Figure 6-2 Program Record Sheet



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Program Record Sheet, continued

Figure 6-2 Program Record Sheet, Continued

Prompt	Function	Segment	Value	Prompt	Function	Segment	Value
STRT SEG	Start Seg.			**SG12 SP**	Soak SP	12	
END SEG	End Seg.			**SG12TIME**	Soak Time	12	
RECYCLES	Number of Recycles			**SG13RAMP**	Ramp Time	13	
SEG1RAMP	Ramp Time	1		**SG14 SP**	Soak SP	14	
SEG2 SP	Soak SP	2		**SG14TIME**	Soak Time	14	
SEG2TIME	Soak Time	2		**SG15RAMP**	Ramp Time	15	
SEG3RAMP	Ramp Time	3		**SG16SP**	Soak SP	16	
SEG4 SP	Soak SP	4		**SG16TIME**	Soak Time	16	
SEG4TIME	Soak Time	4		**SG17RAMP**	Ramp Time	17	
SEG5RAMP	Ramp Time	5		**SG18 SP**	Soak SP	18	
SEG6 SP	Soak SP	6		**SG18 TIME**	Soak Time	18	
SEG6TIME	Soak Time	6		**SG19RAMP**	Ramp Time	19	
SEG7RAMP	Ramp Time	7		**SG20SP**	Soak SP	20	
SEG8 SP	Soak SP	8		**SG20 TIME**	Soak Time	20	
SEG8TIME	Soak Time	8		**GUAR SOAK**	Guaranteed Soak Deviation		
SEG9RAMP	Ramp Time	9		**PROG END**	Controller Status		
SG10 SP	Soak SP	10		**STATE**	Controller State at end		
SG10 TIME	Soak Time	10		**POWER UP**	Power Outage		
SG11RAMP	Ramp Time	11		**RAMP UNIT**	Engr. Unit for Ramp		

6.4 Entering the Setpoint Program Data

Introduction

The procedure listed in table 6-1 tells you what keys to press and what prompts you will see when entering the setpoint program data. Follow the prompt hierarchy listed in table 6-2 when selecting the functions for setpoint programming.

ATTENTION Make sure SP RAMP is disabled first.

Table 6-1 Setpoint Program Data Entry Procedure

Step	Action	Press	Result
1	Select SP Ramp Group	SET UP until you see	Upper Display SET UP Lower Display SP RAMP
2	Select SP PROG Group	FUNC until you see	Upper Display ENABLE ENABL2 ENABL12 Lower Display SP PROG
		▲ or ▼	to enable the setpoint programming option on Loop 1, Loop 2, or both.
3	Select the functions	FUNC	This accesses the function prompts for SP Programming. Upper Display — Shows current value for each prompt Lower Display — The individual function prompts within the setpoint program group are shown. Successive presses of the [FUNCTION] key will sequentially display all the functions and their values or selections. Follow the prompt hierarchy shown in table 6-2.
4	Change the value or selection of a function prompt	▲ or ▼	This changes the value or selection in the upper display. If the display blinks, you are trying to select an unacceptable value.
5	Enter Value or selection into memory	FUNC	This enters the value or selection and goes to another prompt. Repeat steps 4 and 5 for each function you want to change.
6	Exit configuration	LOWR DISP	This exits from the configuration mode.

Alarms on the Setpoint Program

You can configure an event to go ON or OFF at the beginning or end of any segment. Refer to *Section 3 - Configuration* under *"Alarms Parameters Group"* for details.

Continued on next page

Prompt Hierarchy

Table 6-2 lists all the function prompts for Setpoint Program data configuration in the order of their appearance.

Follow the procedure in Table 6-1 to transfer the data from your setpoint Ramp/Soak profile into the controller.

All parameters may be changed while program is disabled or in HOLD.

Table 6-2 Prompt Hierarchy and Available Selections

Prompt (Lower Display)	Definition	Value or Selection (use ▲ or ▼) (Upper Display)
SP RAMP	Setpoint Ramp selection	*Selections*: DISABLE **SP RAMP must be disabled to allow Setpoint Programming.**
SP PROG	Setpoint Ramp/Soak Programming	*Selections*: DISABL ENABLE - Loop 1 ENABL2 - Loop 2 ENABL12 - Loop 1 and 2 **SP PROG must be enabled to view the remaining prompts.**
STRT SEG	Start Segment Number	*Enter Value*: 1 to 19
END SEG	End Segment Number	*Enter Value*: 2 to 20 Always end in a soak Segment (2,4,.....20)
RECYCLES	Number of Program Recycles	*Enter Value*: 0 to 99 recycles
SEG1RAMP	Segment #1 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min **Select HRS:MIN or DEG/MIN at prompt "RAMP UNIT".** **All ramps will use the same selection.**
SEG2 SP	Segment #2 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SEG2TIME	Segment #2 Soak Duration	*Enter Value*: 0-99hrs:0-59min
SEG3RAMP	Segment #3 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min
SEG4 SP	Segment #4 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SEG4TIME	Segment #4 Soak Duration	*Enter Value*: 0-99hrs:0-59min
SEG5RAMP	Segment #5 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min

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Prompt Hierarchy (continued)

Table 6-2 Prompt Hierarchy and Available Selections, continued

Prompt	Definition	Value or Selection (use ▲ or ▼)
SEG6 SP	Segment #6 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SEG6TIME	Segment #6 Soak Duration	*Enter Value*: 0-99hrs:0-59min
SEG7RAMP	Segment #7 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min
SEG8 SP	Segment #8 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SEG8TIME	Segment #8 Soak Duration	*Enter Value*: 0-99hrs:0-59min
SEG9RAMP	Segment #9 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min
SG10 SP	Segment #10 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SG10TIME	Segment #10 Soak Duration	*Enter Value*: 0-99hrs:0-59min
SG11RAMP	Segment #11 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min
SG12 SP	Segment #12 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SG12TIME	Segment #12 Soak Duration	*Enter Value*: 0-99hrs:0-59min
SG13RAMP	Segment #13 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min
SG14 SP	Segment #14 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SG14TIME	Segment #14 Soak Duration	*Enter Value*: 0-99hrs:0-59min
SG15RAMP	Segment #15 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min
SG16 SP	Segment #16 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SG16TIME	Segment #16 Soak Duration	*Enter Value*: 0-99hrs:0-59min

Table 6-2 continued on next page

Prompt Hierarchy (continued)

Table 6-2 Prompt Hierarchy and Available Selections, continued

Prompt	Definition	Value or Selection (use ▲ or ▼)
SG17RAMP	Segment #17 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min
SG18 SP	Segment #18 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SG18TIME	Segment #18 Soak Duration	*Enter Value*: 0-99hrs:0-59min
SG19RAMP	Segment #19 Ramp Time	*Enter Value*: Ramp Time = 0-99hrs:0-59min, or 0-999 degrees/min
SG20 SP	Segment #20 Soak Setpoint Value	*Enter Value*: Within the Setpoint limits
SG20TIME	Segment #20 Soak Duration	*Enter Value*: 0-99hrs:0-59min
GUARSOAK	Guaranteed Soak Deviation	*Selections:* ENABLE DISABL If enabled, you can select a positive or negative deviation for all soak segments. See next prompt.
SKDEV+XX **or** **SKDEV–XX**	Guaranteed Soak Positive or Negative Deviation Value	*Enter Value*: 0 to ± 99 The number selected will be 0 to 99± from setpoint.
STATE	Program state at program end	*Selections:* DISABLE HOLD(hold mode)
PROG END	Program Termination State	*Selections*: LAST SP - Hold at last setpoint in the program F SAFE - Manual mode/Failsafe output
POWER UP	Program Status at Power up from Power Outage	*Selections:* ABORT RESUME RESTART
RAMPUNIT	Engineering units for ramp segments	*Selections*: TIME RATE

6.5 Run/Monitor the Program

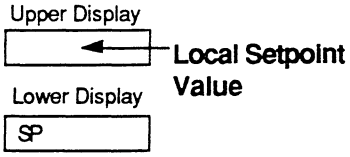
Introduction

Make sure all the "SP PROG" function prompts under the Set Up group "SP RAMP" have been configured with the required data.
An "H" will appear in the upper display indicating that the program is in the HOLD state.

Run/Monitor functions

Table 6-3 lists all the functions required to run and monitor the program.

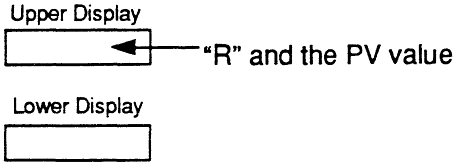
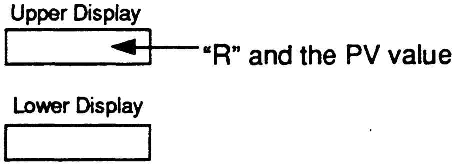
Table 6-3 Run/Monitor Functions

Function	Press	Result
Set the Local Setpoint	SP1 SP2	You will see  Upper Display Local Setpoint Value Lower Display SP
	▲ or ▼	To set the Local Setpoint value to where you want the program to start out.
Run State	RUN HOLD	Initiates the setpoint program. An "R" appears in the upper display indicating that the program is running.
Hold State	RUN HOLD	Holds the setpoint program. An "H" appears in the upper display indicating that the program is in the HOLD state. The setpoint holds at the current setpoint.
External Hold		If Remote Switching is present on your controller, contact closure places the controller in the HOLD state, if the setpoint program is running. The "H" in the upper display will blink. ATTENTION The keyboard takes priority over external switch for the RUN/HOLD function. Contact reopening runs program.
Changing a Segment while in Hold	▲ or ▼	These keys will operate and allow you to change the segment number while in HOLD. If a different segment is selected, it will be started at the beginning when placed in RUN. If the original segment is brought back, it will continue from the point placed in HOLD. NOTE: changing a segment number may affect the alarms/events.

Continued on next page

Run/Monitor functions (continued)

Table 6-3 Run/Monitor Functions, continued

Function	Press	Result
Viewing the present ramp or soak segment number and time	LOWR DISP until you see	 For Ramp segments: **# RA XX.XX** Ramp Time - Hours:Minutes or Ramp Rate - Degrees/Minute Indicates Ramp segment Segment Number (odd only) For Soak segments: **# SK XX.XX** Time remaining in segment in Hrs:Minutes including current partially completed minute Indicates Soak segment Segment Number (even only)
Viewing the number of cycles left in the program	LOWR DISP until you see	 **RECYC XX** Remaining Cycles 0 to 99 This number includes the current partially completed cycle.
End Program		When the final segment is completed, the "R" in the upper display either changes to "H" if configured for HOLD state, or disappears if configured for disable of setpoint programming. The controller operates at the last setpoint in the program in automatic or will be in manual mode at the failsafe output.

Power-up state

The program will be placed in HOLD mode at the beginning of the program at the local Setpoint value prior to the beginning of the program.

Section 7 – Input Calibration

7.1 Overview

Introduction

This section describes the field calibration procedures for Input 1, Input 2, and Optional Input 3.

Every UDC5000 controller contains all input actuation ranges fully factory calibrated and ready for configuration to range by the user.

However these procedures can be implemented if the factory calibration of the desired range is not within specifications.

Note that the field calibration will be lost if a change in input type configuration is implemented at a later time. The original factory calibration data remains available for later use after a field calibration is done.

What's in this section

This section contains the following topics:

Topic		See Page
7.2	Minimum and maximum range values	194
7.3	Input 1 and 2 Preliminary Information	195
7.4	Input 1 and 2 Set Up Wiring	197
7.5	Input 1 and 2 Calibration Procedure	204
7.6	Input 3 Preliminary Information	206
7.7	Input 3 Set Up Wiring	207
7.8	Input 3 Calibration Procedure	208

Calibration steps

Use the following steps when calibrating an input.

Step	Action
1	Find the minimum and maximum range values for your PV input range from Table 7-1.
2	Disconnect the field wiring and find out what equipment you will need to calibrate. DO NOT remove external resistor assemblies (if present).
3	Wire the calibrating device to your controller according to the Set Up wiring instructions for your particular input.
4	Follow the calibration procedure given for Input #1, #2 or #3

7.2 Minimum and Maximum Range Values

Select the range values You should calibrate the controller for the minimum (0%) and Maximum (100%) range values of your particular sensor.

If you have a two input controller, calibrate each input separately.

Select the Voltage or Resistance equivalent for 0% and 100% range values from Table 7-1. Use these value when calibrating your controller.

Table 7-1 Voltage and Resistance Equivalents for 0% and 100% Range Values

Sensor Type	PV Input Range		Range Values	
	°F	°C	0%	100%
B Thermocouple	105 to 3300	41 to 1816	0 mV	13.763 mV
E Thermocouple	-454 to 1832	–270 to 1000	–9.835 mV	76.358 mV
E Thermocouple(Low)	-200 to 1100	–129 to 593	–6.471 mV	44.547 mV
J Thermocouple	0 to 1600	–18 to 871	–0.885 mV	50.059 mV
J Thermocouple(Low)	20 to 770	–7 to 410	–0.334 mV	22.397 mV
K Thermocouple	0 to 2400	–18 to 1316	–0.692 mV	52.939 mV
K Thermocouple(Low)	-20 to 1000	–29 to 538	–1.114 mV	22.251 mV
NiNiMoly T/C	32 to 2500	0 to 1371	–0.001 mV	71.330 mV
NiNiMoly (Low)	32 to 1260	0 to 682	–0.001 mV	31.820 mV
Nicrosil Nisil T/C	0 to 2372	–18 to 1300	–0.461 mV	47.502 mV
R Thermocouple	0 to 3100	–18 to 1704	–0.089 mV	20.275 mV
S Thermocouple	0 to 3100	–18 to 1704	–0.092 mV	17.993 mV
T Thermocouple	-300 to 700	–184 to 371	–5.341 mV	19.095 mV
T Thermocouple(Low)	-200 to 600	–129 to 316	–4.149 mV	15.769 mV
W5W26 T/C	0 to 4200	–18 to 2316	–0.234 mV	37.066 mV
W5W26 T/C(Low)	0 to 2240	–18 to 1227	–0.234 mV	22.277 mV
RTD (IEC=0.00385)				
100 Ohms	-300 to 900	–184 to 482	25.18 ohms	274.96 ohms
100 Ohms (low)	0 to 300	–18 to 149	93.03 ohms	156.90 ohms
200 Ohms	-300 to 900	–184 to 482	50.36 ohms	549.92 ohms
500 Ohms	-300 to 900	–184 to 482	125.90 ohms	1374.80 ohms
Radiamatic (RH)	1400 to 3400	760 to 1871	0.99 mV	57.12 mV
Carbon Probe	0 to 2.0% Carbon		0 mV	1250 mV
Relative Humidity	21 to 212	–6 to 100	97.65 Ohms	138.50 Ohms
Dew Point	–50 to 100	–46 to 38	0 mV	1250 mV
Oxygen Probe	0 to 40% Oxygen		–30 mV	510 mV
Linear				
Milliamps	4 to 20 mA		4 mA	20 mA
Millivolts	0 to 10 mV		0 mV	10 mV
	10 to 50 mV		10 mV	50 mV
Volts	1 to 5 Volts		1 Volt	5 Volts
	0 to 10 Volts		0 Volts	10 Volts

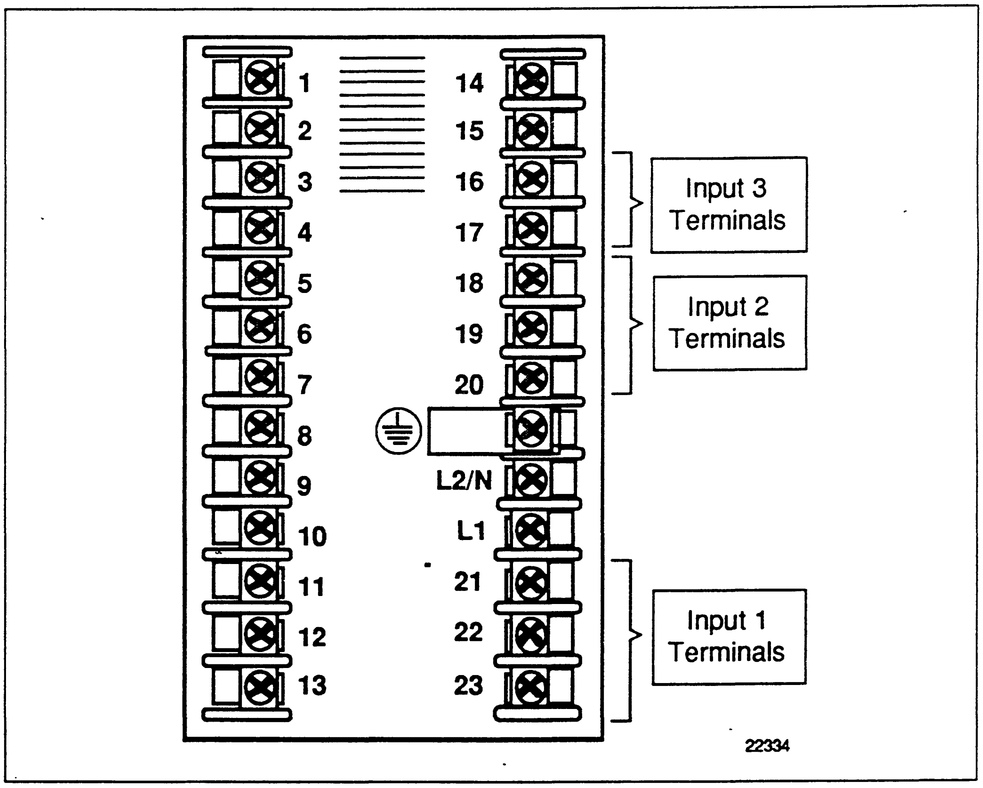
7.3 Inputs 1 and 2 Preliminary Information

Disconnect the field wiring

Depending on which input (#1 or 2) you are going to calibrate, tag and disconnect any field wiring connected to the input terminals on the rear of the controller.

Figure 7-1 shows the wiring terminal designations for Input #1 and #2.

Figure 7-1 Input #1 and #2 Wiring Terminals



Changing the input group type

When you change from some groups to others, (for example: 4–20mA to Thermocouple) you must adapt the input circuitry so that it will be compatible with the input signal. This includes configuration of an input type and the installation and removal of jumpers on the controller printed wiring board.

Refer to *Section 3 - Configuration* to select the input type and *Section 2 - Installation* to determine your jumper and resistor requirements.

Continued on next page

Equipment needed

Table 7-2 lists the equipment you will need to calibrate the specific types of inputs that are listed in Table 7-1. You will need a screwdriver to connect these devices to your controller.

Table 7-2 Equipment Needed

Type of Input	Equipment Needed
Thermocouple Inputs (Ice Bath)	• A calibrating device with ±0.01% accuracy for use as a signal source such as a millivolt source. • Thermocouple extension wire that corresponds with the type of thermocouple that will be used with the controller input. • Two insulated copper leads for connecting the thermocouple extension wire from the ice baths to the precision calibrator. • Two containers of crushed ice.
Thermocouple Inputs (Precision Resistor)	• A calibrating device with ±0.01% accuracy for use as a signal source such as a millivolt source. • Two insulated copper leads for connecting the calibrator to the controller. • A precision 500 ohm resistor ±0.1% connected across input #5 terminals 1(R) and 3(–).
Thermocouple Inputs (Ambient Temperature)	• A calibrating device with ±0.02% accuracy for use as a signal source such as a millivolt source. • Two insulated copper leads for connecting the calibrator to the controller.
RTD (Resistance Thermometer Device) and Relative Humidity Inputs	• A decade box, with ±0.01% accuracy, capable of providing stepped resistance values over a minimum range of 0 to 1400 Ohms with a resolution of 0.1 ohm. • Three insulated copper leads for connecting the decade box to the controller.
Milliampere, Millivolt, Volts, Radiamatic, Carbon Potential Inputs, Dewpoint ranges, and Oxygen ranges.	• A calibrating device with ±0.01% accuracy for use as a signal source. • Two insulated copper leads for connecting the calibrator to the controller. • Place current source at zero before switching ON. • Do not switch current sources OFF/ON while connected to the UDC5000 input.

7.4 Inputs #1 and #2 Set Up Wiring

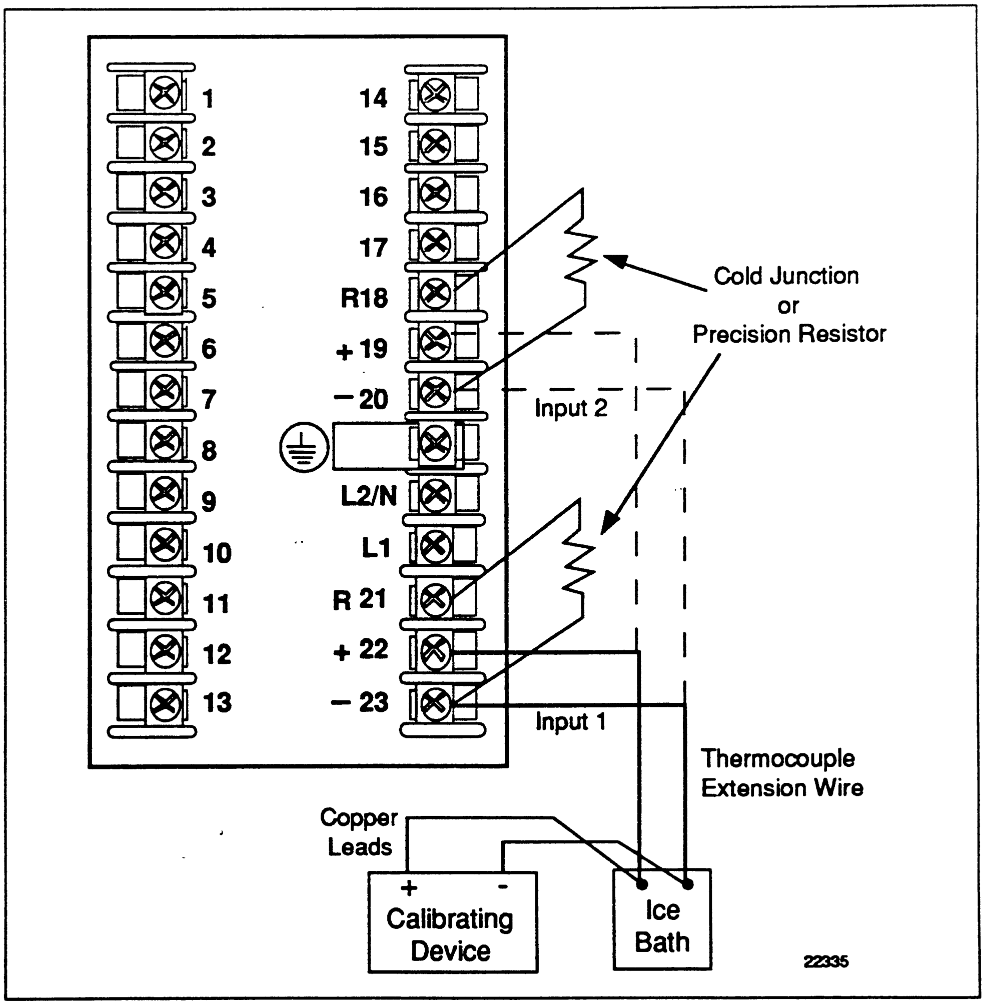
Thermocouple Inputs using an Ice bath

Refer to Figure 7-2 and wire the controller according to the procedure given in Table 7-3.

Table 7-3 Set Up Wiring Procedure for Thermocouple Inputs Using An Ice Bath

Step	Action
1	Connect the copper leads to the calibrator.
2	Connect a length of thermocouple extension wire to the end of each copper lead and insert the junction points into the ice bath.
3	Connect the thermocouple extension wires to the terminals for Input #1 or Input #2. See Figure 7-2.
4	Connect a Cold junction resistor between terminals 21 and 23 (Input #1) or terminals 18 and 20 (Input #2).

Figure 7-2 Wiring Connections for T/C Inputs Using an Ice Bath



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Thermocouple Inputs using a precision resistor

Refer to Figure 7-3 and wire the controller according to the procedure given in Table 7-4.

Table 7-4 Set Up Wiring Procedure for Thermocouple Inputs Using a Precision Resistor

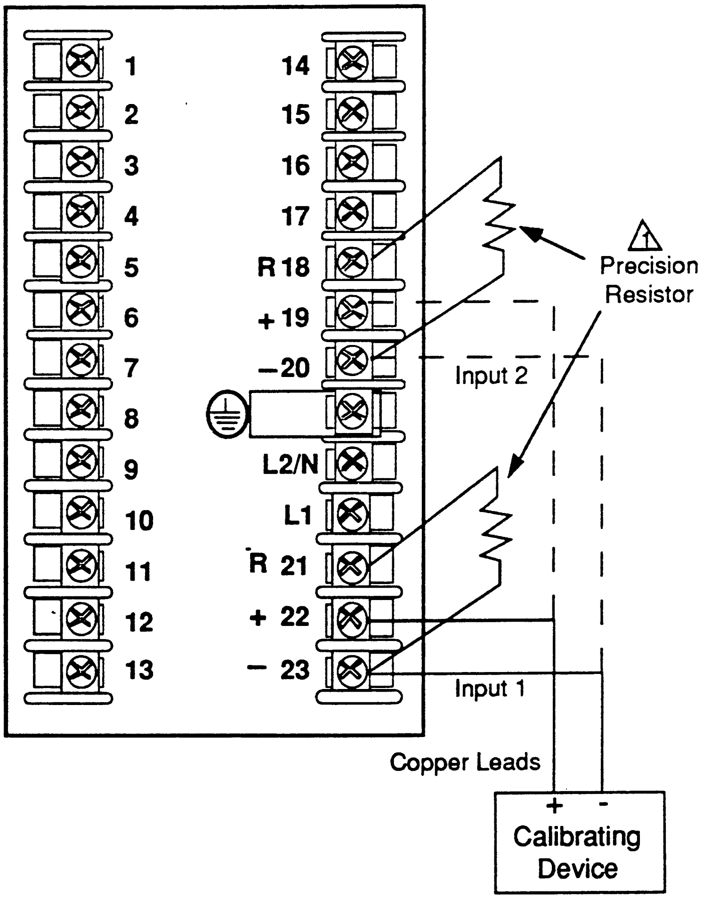
Step	Action
1	Connect the copper leads to the calibrator.
2	Disconnect the cold junction resistor.
3	Install a 500 Ohm precision resistor across terminal 21 and 23 (Input #1) or terminals 18 and 20 (Input #2). See figure 7-3.
4	Subtract the millivolt value for 77°F (25°C) from the zero and span value for your range (see Table 7-1 for zero and span values) and use the adjusted value when calibrating. **ATTENTION** If a precision 500 Ohm resistor is not available, a resistor with a value of between 490 and 510 Ohms may be substituted with the following temperature correction: °C For each 0.2 ohms difference greater than 500 ohms, add 0.1 °C to both the T/C table and the cold junction setting. Likewise, for each 0.2 ohms difference less than 500 ohms, subtract 0.1 °C from both the T/C table and the C/J temperature. °F Same as °C, except 0.1 ohms/0.1°F. Accuracy for this method is limited to the accuracy of the resistance measurement.

Continued on next page

7.4 Inputs #1 and #2 Set Up Wiring, Continued

Thermocouple inputs using a precision resistor, continued

Figure 7-3 Wiring Connections for Thermocouple Inputs Using a Precision Resistor



⚠ **ATTENTION**

The accuracy of the controller is directly affected by the accuracy of this resistor. At a minimum, use a 0.1% 25 PPM resistor.

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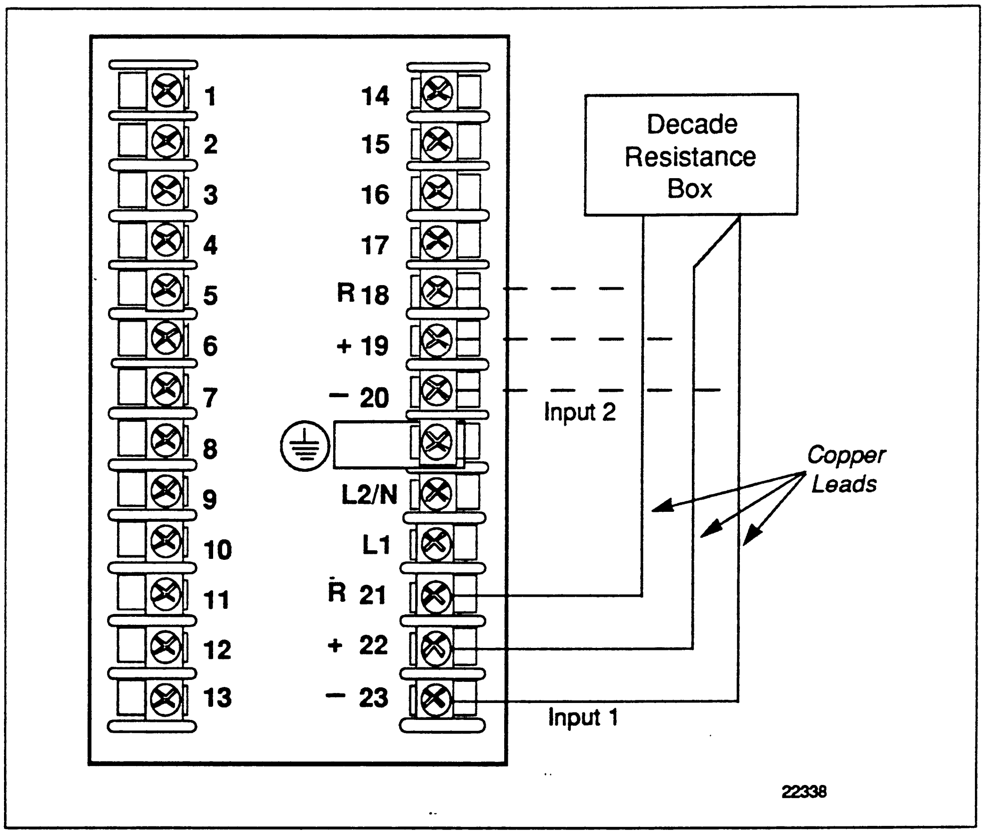
Continued on next page

RTD Inputs or Relative Humidity Inputs

Use the copper leads and connect the calibrator to the rear terminals of Input #1 or #2. See Figure 7-4.

Figure 7-4 Wiring Connections for RTD (Resistance Thermometer Device) or Relative Humidity Inputs



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Radiamatic, Millivolts, Volts, milliamps Inputs, Carbon Potential Inputs, Dewpoint ranges, and oxygen ranges

Use the copper leads and connect the calibrator to the rear terminals of Input #1 or #2. See Figure 7-5.

Refer to Table 7-5 for additional information concerning these inputs and ranges.

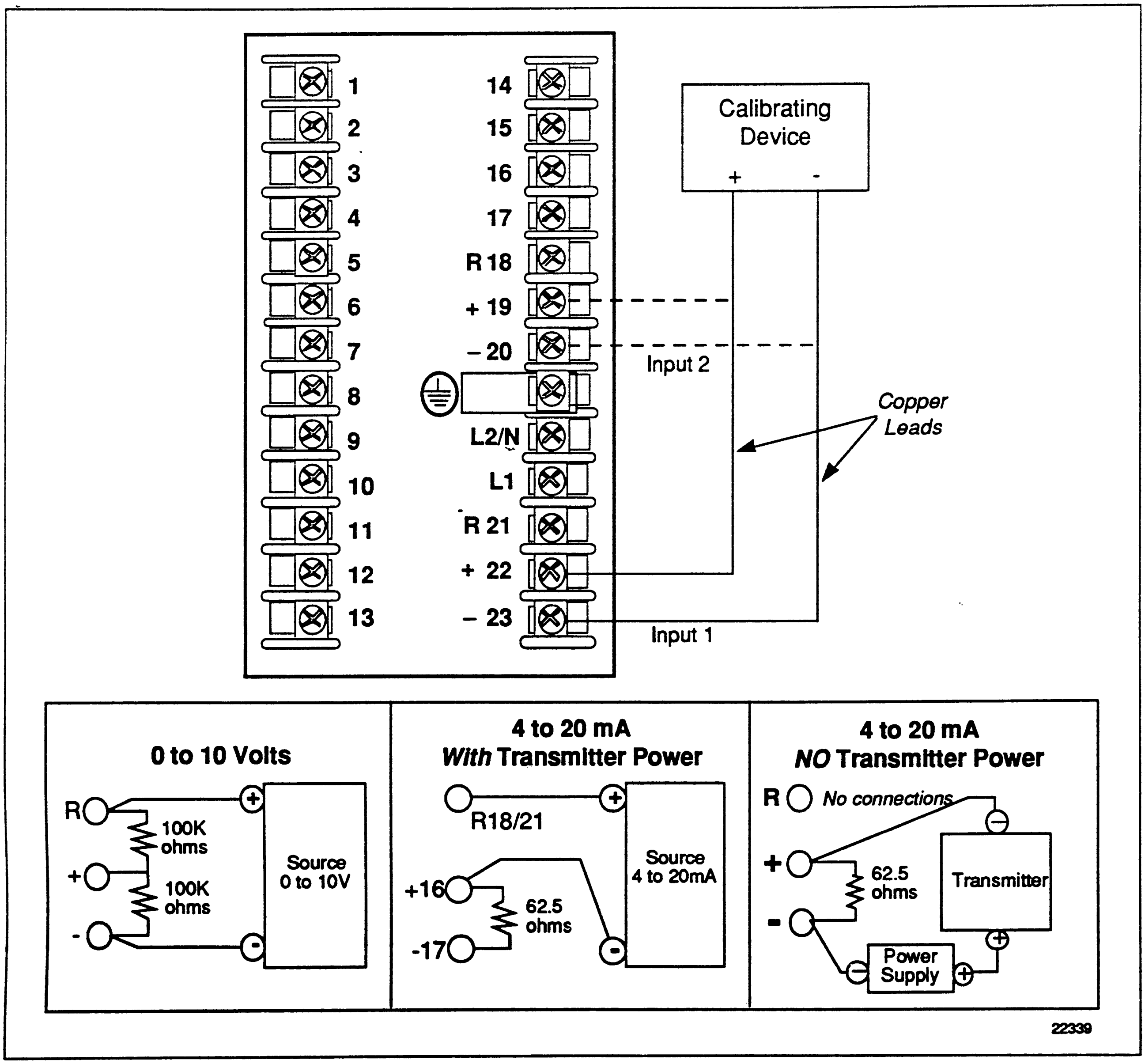
Table 7-5 Calibration Information

Input or Range	Calibration Information
Transmitter Power Option	Use the wiring diagram for 4 to 20 mA, NO transmitter power; calibrate, then return the connections to those shown on the wiring diagram for 4 to 20 mA WITH transmitter power.
Radiamatic Inputs	Set the Emissivity for Input #1 or Input #2 to a value of 1.0. Refer to Section 3 - Configuration under SET UP prompt "INPUT 1" FUNCTION prompt "EMISSIVITY1' SET UP prompt "INPUT 2" FUNCTION prompt "EMISSIVITY2'
Carbon Potential Ranges	Calibrate Input #1 for any desired actuation type which will operate within the region of 900°F to 2000°F. Calibrate Input #2 for 0 to 1250 millivolts.
Dewpoint Ranges	Calibrate Input #1 for any desired actuation type which will operate within the region of 1000°F to 2200°F. Calibrate Input #2 for 0 to 1250 millivolts.
Oxygen Ranges	Calibrate Input #1 for any desired actuation type which will operate within the region of 800°F to 3000°F. Calibrate Input #2 for –30 to 510 millivolts.

Continued on next page

Radiamatic, Millivolts, Volts, milliamps inputs, Carbon Potential inputs, Dewpoint ranges, and oxygen ranges, continued

Figure 7-5 Wiring Connections for Radiamatic, Millivolts, Volts, Milliamps, Carbon Potential, Dewpoint, or Oxygen Ranges



7.5 Inputs #1 and #2 Calibration Procedure

Introduction

Apply power and allow the controller to warm up for 1 hour before you calibrate.
Please read "*Set Up Wiring*" before beginning the procedure.
Make sure you have "LOCKOUT" set to "NONE." See *Section 3 – Configuration.*

ATTENTION For linear inputs, avoid step changes in inputs. Vary smoothly from initial value to final 100% value.

Procedure

The Calibration procedure is the same for Input #1 and #2 except that the displays will indicate 1 or 2. The procedure is listed in Table 7-6.

Table 7-6 Input #1 and #2 Calibration Procedure

Step	Description	Press	Action
1	Enter Calibration Mode for the Input selected	SET UP until you see	Upper Display CALIB Lower Display INPUT X X = 1 or 2
		FUNC	You will see: Upper Display DISABL Lower Display CAL INX X = 1 or 2
		▲	The calibration sequence is enabled and you will see: Upper Display BEGIN Lower Display CAL INX X = 1 or 2 At the completion of the sequence, the selection automatically reverts to disable.
2	Calibrate 0%	FUNC	You will see: Upper Display APPLY Lower Display INX ZERO X = 1 or 2 Adjust your calibration device to an output signal equal to the 0% range value for your particular input sensor. Wait 15 seconds, then go to the next step.

Table 7-6 continued on next page

Table 7-6 Input #1 and #2 Calibration Procedure, continued

<table>
<tr><th>Step</th><th>Description</th><th>Press</th><th>Action</th></tr>
<tr><td>3</td><td>Calibrate 100 %</td><td>FUNC</td><td>You will see:
Upper Display
APPLY
Lower Display
INX SPAN X = 1 or 2
Adjust your calibration device to an output signal equal to the 100% range value for your particular input sensor.
Wait 15 seconds, and
<table>
<tr><th>If...</th><th>Then...</th></tr>
<tr><td>you are calibrating a Thermocouple input</td><td>Go to step 4</td></tr>
<tr><td>you are calibrating other than a Thermocouple input</td><td>Go to step 5</td></tr>
</table></td></tr>
<tr><td>4</td><td>Check the Cold Junction Temperature
ATTENTION
The accuracy of the controller is directly affected by the accuracy of this value. Change this value only if the zero and span calibration procedures did not bring the controller within the specified accuracy requirements.</td><td>FUNC</td><td>The calculations for zero and span are now stored and you will see:
Upper Display
← The cold junction temperature at the rear terminals
Lower Display
CJ TEMP
Remove the cold junction resistor from rear terminals #21 and #23 and connect a precision 500 Ohm resistor in place of the cold junction.
Enter a value of 77.0 if the °F indicator is lit, or 25.0 if the °C indicator is lit.</td></tr>
<tr><td>5</td><td>Exit the Calibration Mode</td><td>FUNC
then
LOWR DISP</td><td>The controller will store the calibration constants and exit calibration mode.
To exit the calibration mode.</td></tr>
</table>

7.6 Input 3 Preliminary Information

Equipment needed

Table 7-7 lists the equipment you will need to calibrate the Milliamp or Volt ranges that are available for Input #3. You will need a screwdriver to connect these devices to your controller.

Table 7-7 Equipment Needed

Type of Input	Equipment Needed
Milliampere,or Volts	• A calibrating device with ±0.01% accuracy for use as a signal source. • Two insulated copper leads for connecting the calibrator to the controller. • Place current source at zero before switching ON. • Do not switch current sources OFF/ON while connected to the UDC5000 input.

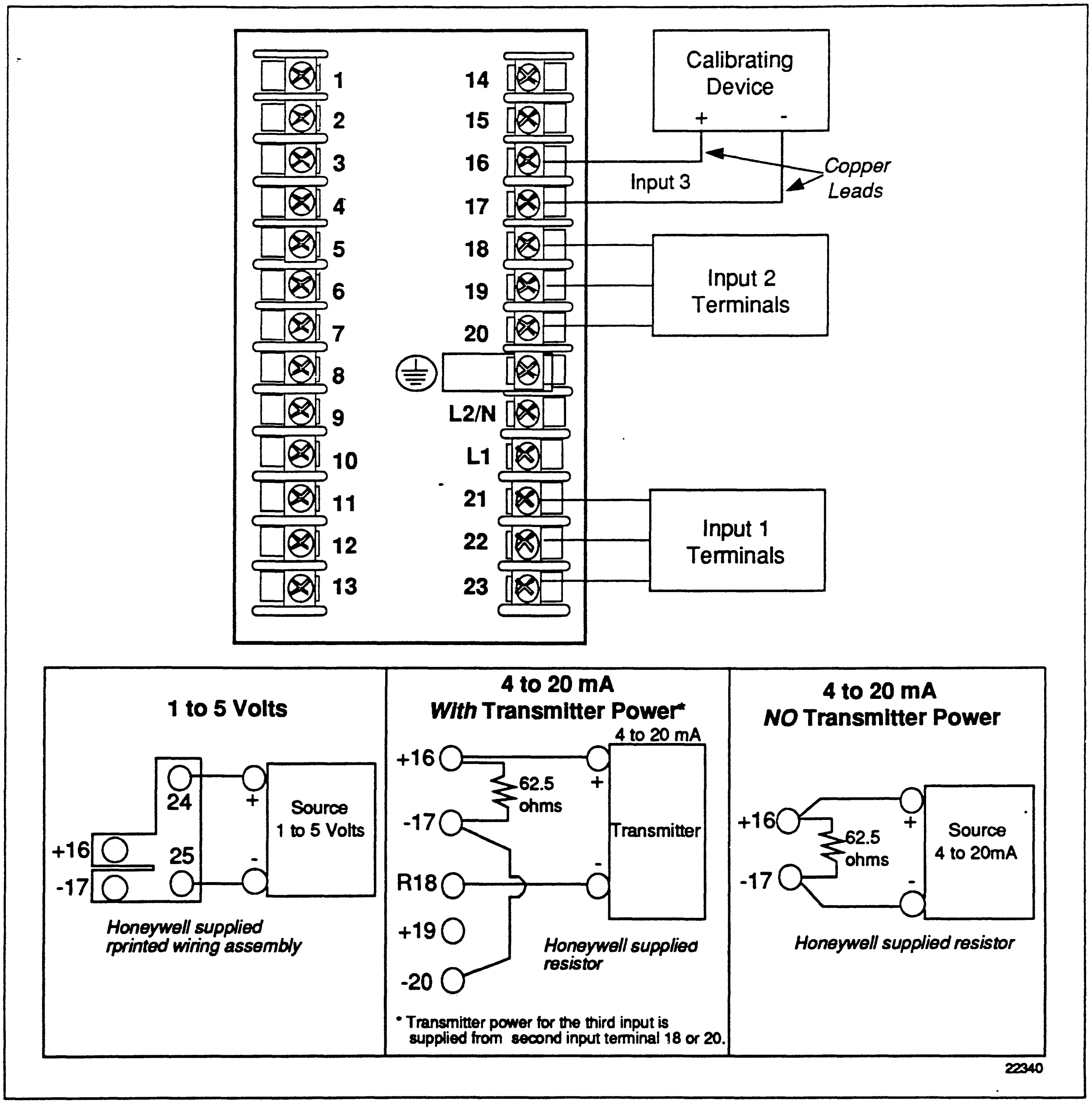
Continued on next page

7.7 Input 3 Set Up Wiring

1 to 5 Volts or 4–20 mA Inputs

Use the copper leads and connect the calibrator to the rear terminals of Input #3. See Figure 7-6.

Figure 7-6 Wiring Connections for 1 to 5 Volts or 4 to 20 mA


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
L2/N
L1
21
22
23
Calibrating Device
+
-
Input 3
Copper Leads
Input 2 Terminals
Input 1 Terminals
1 to 5 Volts
24
25
+16
-17
+
-
Source 1 to 5 Volts
Honeywell supplied printed wiring assembly
4 to 20 mA With Transmitter Power*
4 to 20 mA
+16
-17
R18
+19
-20
62.5 ohms
Transmitter
Honeywell supplied resistor
* Transmitter power for the third input is supplied from second input terminal 18 or 20.
4 to 20 mA NO Transmitter Power
+16
-17
62.5 ohms
Source 4 to 20mA
Honeywell supplied resistor
22340

7.8 Input #3 Calibration Procedure

Introduction

Apply power and allow the controller to warm up for 1 hour before you calibrate.
Please read "*Set Up Wiring*" before beginning the procedure.
Make sure you have "LOCKOUT" set to "NONE." See *Section 3 – Configuration*.

ATTENTION For linear inputs, avoid step changes in inputs. Vary smoothly from initial value to final 100% value.

Procedure

The Calibration procedure is listed in Table 7-8.

Table 7-8 Input #3 Calibration Procedure

Step	Description	Press	Action
1	Enter Calibration Mode for the Input selected	SET UP until you see	Upper Display CALIB Lower Display INPUT 3
		FUNC	You will see: Upper Display DISABL Lower Display CAL IN3
		▲	The calibration sequence is enabled and you will see: Upper Display BEGIN Lower Display CAL IN3 At the completion of the sequence, the selection automatically reverts to disable.
2	Calibrate 0%	FUNC	You will see: Upper Display APPLY Lower Display IN3 ZERO Adjust your calibration device to an output signal equal to the 0% range value for your particular input sensor. Wait 15 seconds, then go to the next step.

Table 7-8 continued on next page

7.8 Input #3 Calibration Procedure, Continued

Table 7-8 Input #3 Calibration Procedure, continued

Step	Description	Press	Action
3	Calibrate 100 %	FUNC	You will see: Upper Display APPLY Lower Display IN3 SPAN Adjust your calibration device to an output signal equal to the 100% range value for your particular input sensor.
4	Exit the Calibration Mode	FUNC or LOWR DISP	The controller will store the calibration constants and exit calibration mode. To exit the calibration mode

Section 8 – Output Calibration

8.1 Overview

Introduction

This section describes the field calibration procedures for the following types of outputs:

- Current Output
- Position Proportional and 3 Position Step Output
- Auxiliary Output

What's in this section

This section contains the following topics:

Topic	See Page
8.1 Overview	209
8.2 Current Proportional Output Calibration	210
8.3 Position Proportional and Three Position Step Output Calibration	213
8.4 Auxiliary Output Calibration	217

8.2 Current Proportional Output Calibration

Introduction

Calibrate the controller so that the output provides the proper amount of current over the desired range.

The controller can provide an output current range of from 0 to 21 milliamperes and can be calibrated at 4 mA for 0% of output and 20 mA for 100% of output or any other values between 0 and 21 mA.

ATTENTION We recommend that the expected output load be connected for optimum accuracy.

Equipment needed

You will need a standard shop type milliammeter, with whatever accuracy is required, capable of measuring 0 to 20 milliamps.

Calibrator connections

Refer to Figure 8-1 and wire the controller according to the procedure given in Table 8-1.

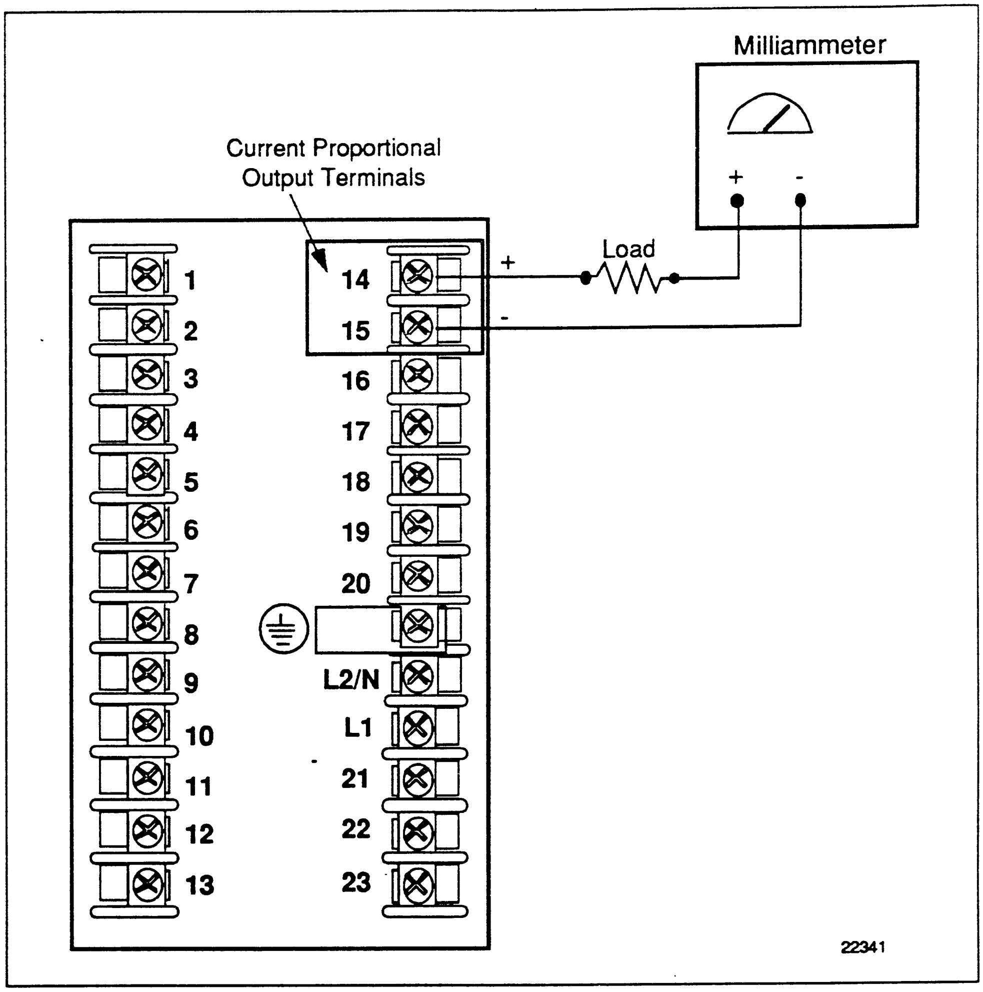
Table 8-1 Set Up Wiring Procedure Current Proportional Output

Step	Action
1	Apply power and allow the controller to warm up 15 minutes before you calibrate.
2	Tag and disconnect the field wiring, at the rear of the controller, from terminals 14(+) and 15(–). See Figure 8-1.
3	Connect a Milliammeter across these terminals. A load resistor equivalent to the process load should be connected in series with the millammeter.

Continued on next page

Calibrator connections, continued

Figure 8-1 Wiring Connections for Calibrating Current Proportional Output



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8.2 Current Proportional Output Calibration, Continued

Procedure

The procedure for calibrating the Current Proportional Output is listed in Table 8-2. Make sure "LOCKOUT" in the Tuning Set Up group is set to "NONE." See *Section 3 – Configuration.*

Table 8-2 Current Proportional Output Calibration Procedure

Step	Description	Press	Action
1	Enter Calibration Mode	SET UP until you see	Upper Display CALIB Lower Display CURRENT
2	Calibrate 0%	FUNC	You will see: Upper Display ← a value between 1 and 2048 Lower Display ZERO VAL
		▲ or ▼	until the desired 0% output is read on the milliammeter. Use the values shown below depending on the action of your controller. 0 mA For 0 to 20 mA Direct Action* 20 mA For 0 to 20 mA Reverse Action 4 mA For 4 to 20 mA Direct Action 20 mA For 4 to 20 mA Reverse Action
3	Calibrate 100%	FUNC	This stores the 0%value and, You will see: Upper Display ← a value between 1 and 2048 Lower Display SPAN VAL
		▲ or ▼	until the desired 100% output is read on the milliammeter. Use the values shown below depending on the action of your controller. 20 mA For 0 to 20 mA Direct Action 0 mA For 0 to 20 mA Reverse Action* 20 mA For 4 to 20 mA Direct Action 4 mA For 4 to 20 mA Reverse Action
4	Exit the Calibration Mode	FUNC	The controller will store the span value.
		LOWR DISP or SET UP	To exit the calibration mode. * When attempting to achieve 0 mA, always adjust the output to about 0.5 mA, and slowly decrease until the output just goes to zero. Further decrementing will not change the output current (since the circuit cannot produce negative current) but will affect the accuracy of the output by creating a dead zone where no current flows.

8.3 Position Proportional and Three Position Step Output Calibration

Position Proportional control

When the UDC 5000 controller has a Position Proportional control output, calibrate the controller so that the increase and decrease relays operate properly with respect to the position of the external feedback slidewire.

3 Position Step control

Three Position Step Control Output models with Motor Position Indication
This model must have its output calibrated per the entire procedure to ensure that the displayed output (slidewire position) agrees with the final control element position.
Three Position Step Control Output models without Motor Position Indication
This model only requires that the "Motor Time" be entered as shown in the calibration procedure. FULL CALIBRATION IS NOT REQUIRED.

Equipment needed

None

Connections

Apply power and allow the controller to warm up 15 minutes before you calibrate.
Leave all field wiring connected to the rear terminals.

Auto mode vs Manual mode

There are two ways in which to calibrate Position Proportional or 3 Position Step control:
AUTO mode or MANUAL mode.

Rules for Auto mode vs Manual mode

The Auto-mode selection must be done at least once before the manual mode will operate properly. Failure to use the Auto-mode procedure will prevent the controller from going into automatic control mode.

Displayed values

During the Auto-mode calibration procedure, the values being displayed are used only to indicate if the motor is still traveling.
To view the actual calibration value, use the manual mode after the Auto-mode is completed. These values can be changed for purposes of tweaking the calibration.

Continued on next page

8.3 Position Proportional and Three Position Step Output Calibration, Continued

Procedure

The procedure for calibrating the Position Proportional output and 3 Position Step control output is listed in table 8-3.

Make sure "LOCKOUT" in Tuning Set Up group is set to "NONE." See *Section 3 – Configuration.*

For *"Three Position Step Control Output models without Motor Position Indication"*, do steps 1 and 2 only.

For *"Position Proportional Output"* and *"Three Position Step Control Output models with Motor Position Indication"* follow the entire calibration procedure.

Table 8-3 Position Proportional and 3 Position Step Output Calibration Procedure

Step	Description	Press	Action
1	Enter Calibration Mode	SET UP until you see	Upper Display CALIB Lower Display POS PROP
2	Set Motor Traverse Time Note: This is the time it takes the motor to travel from 0 to 100%.	FUNC	Until you see: Upper Display ← a value Lower Display MTR TIME
		▲ or ▼	until the proper motor stroke time is reached (see the motor specs or measure the time) Range of setting = *Position Proportional* -5 to 255 Seconds *3 Position Step* - 15 to 255 Seconds

Continued on next page

Table 8-3 Position Proportional and 3 Position Step Output Calibration Procedure, continued

Step	Description	Press	Action
3	Select Automatic or Manual Calibration	FUNC	until you see: Upper Display DISABLE Lower Display POS PROP You can calibrate the controller output manually or let the controller calibrate the output automatically. If the slidewire has never been calibrated, you must use "DO AUTO" first. In the "Automatic Calibration Mode" (DO AUTO), the controller relays automatically move the motor in the proper direction. If desired, however, the motor may be manually positioned to 0% and 100% positions. Disconnect the relay wires. "DO MAN". In the "Manual Calibration Mode" (DO MAN) the motor does not move. Instead, the existing 0% and 100% values may be changed with the ▲ or ▼ keys.
		▲ or ▼	to select automatic or manual calibration. Upper Display ← **DO AUTO** or **DO MAN** Lower Display POS PROP If you select DO AUTO, go to step 4 If you select DO MAN, go to step 6 Note: When calibration is terminated, this selection reverts to DISABL.
4	**DO AUTO** Set 100% value	FUNC	The decrement relay is turned on to move the motor to 100% position. Upper Display ← counts of feedback slidewire (0 to 1023) PLS WAIT *then,* Lower Display SPAN VAL When the motor stops, the display should stop counting, then, go on to next step. **ATTENTION** The controller may automatically recalibrate the span value a second time.

Continued on next page

8.3 Position Proportional and Three Position Step Output Calibration, Continued

Table 8-3 Position Proportional and 3 Position Step Output Calibration Procedure, continued

Step	Description	Press	Action
5	Set 0% value	FUNC	The increment relay is turned on to move the motor to 0% position. Upper Display [ ] ← counts of feedback slidewire (0 to 1023) PLS WAIT *then,* Lower Display ZERO VAL When the motor stops, the display should stop counting, then, go on to the step 8.
6	**DO MAN** Set 100% value	FUNC	You will see: Upper Display [ ] ← The existing span calibration value in counts Lower Display SPAN VAL
		▲ or ▼	until the desired span value is reached in the upper display. Upper Display [ ] ← The desired span value Lower Display SPAN VAL For manual calibration, the motor does not move from its position prior to the start of Position Proportional calibration.
7	Set 0% value	FUNC	The controller will store the 100% value and you will see: Upper Display [ ] ← The existing zero calibration value in counts. Lower Display ZERO VAL
		▲ or ▼	until the desired zero value is reached in the upper display. Upper Display [ ] ← The desired zero value Lower Display ZERO VAL
8	Exit the Calibration Mode	FUNC	The controller will store the 0% value.
		LOWR DISP or SET UP	To exit the calibration mode.

8.4 Auxiliary Output Calibration

Introduction

Calibrate the controller so that the Auxiliary output provides the proper amount of current over the desired range.
The controller can provide an auxiliary output current range of from 0 to 21 milliamperes and can be calibrated at 4 mA for 0% of output and 20 mA for 100% of output or any other values between 0 and 21 mA.

Equipment needed

You will need a standard shop type milliammeter with whatever accuracy is required, capable of measuring 0 to 20 milliamps.

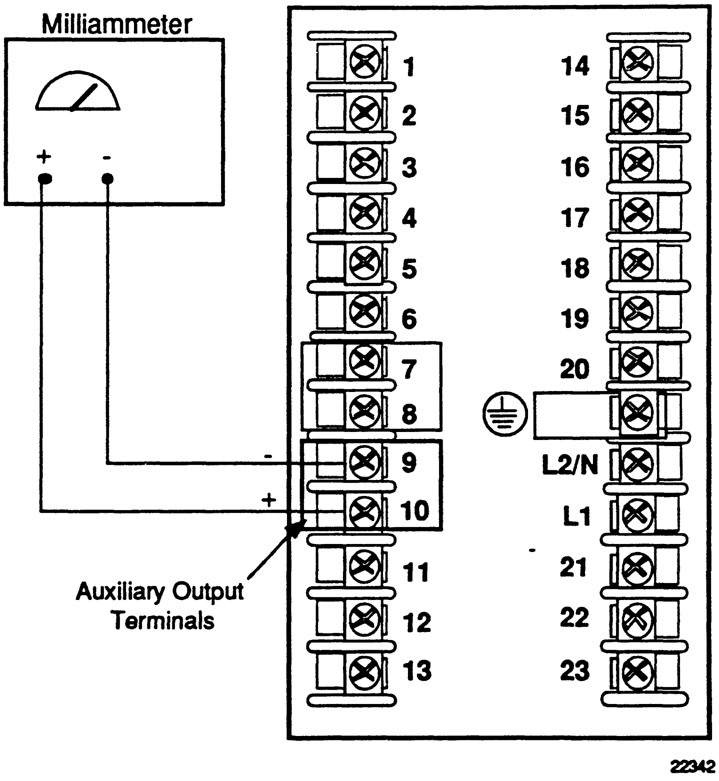
Calibrator connections

Refer to Figure 8-2 and wire the controller according to the procedure given in Table 8-4.

Table 8-4 Set Up Wiring Procedure for Auxiliary Output

Step	Action
1	Apply power and allow the controller to warm up 15 minutes before you calibrate.
2	Tag and disconnect the field wiring, at the rear of the controller, from terminals 10(+) and 9(–). See Figure 8-2. ATTENTION Use **terminals 7 and 8** if Auxiliary Output, Remote mode Switching, and Communications Option are all present.
3	Connect a Milliammeter across these terminals.

Figure 8-2 Wiring Connections for Calibrating Auxiliary Output



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8.4 Auxiliary Output Calibration, Continued

Procedure The procedure for calibrating the Auxiliary Output is listed in Table 8-5. Make sure "LOCKOUT" in the Tuning Set Up group is set to "NONE." See *Section 3 – Configuration.*

Table 8-5 Auxiliary Output Calibration Procedure

Step	Description	Press	Action
1	Enter Calibration Mode	SET UP until you see	Upper Display CALIB Lower Display AUX OUT
2	Calibrate 0%	FUNC	You will see: Upper Display ← a value Lower Display ZERO VAL
		▲ or ▼	until the desired 0% output is read on the milliammeter. Use the values shown below depending on the action of your controller. 0 mA For 0 to 20 mA Direct Action * 20 mA For 0 to 20 mA Reverse Action 4 mA For 4 to 20 mA Direct Action 20 mA For 4 to 20 mA Reverse Action
3	Calibrate 100%	FUNC	This stores the 0%value and, you will see: Upper Display ← a value Lower Display SPAN VAL
		▲ or ▼	until the desired 100% output is read on the milliammeter. Use the values shown below depending on the action of your controller. 20 mA For 0 to 20 mA Direct Action 0 mA For 0 to 20 mA Reverse Action* 20 mA For 4 to 20 mA Direct Action 4 mA For 4 to 20 mA Reverse Action
4	Exit the Calibration Mode	FUNC	The controller will store the span value.
		LOWR DISP or SET UP	To exit the calibration mode. * When attempting to achieve 0 mA, always adjust the output to about 0.5 mA, and slowly decrease until the output just goes to zero. Further decrementing will not change the output current (since the circuit cannot produce negative current) but will affect the accuracy of the output by creating a dead zone where no current flows.

Section 9 – Troubleshooting / Service

9.1 Overview

Introduction

Instrument performance can be adversely affected by installation and application problems as well as hardware problems. We recommend that you investigate the problems in the following order,

- Installation related problems
- Application related problems
- Hardware and software related problems

and use the information presented in this section to solve them.
If a replacement of any part is required, follow the procedures listed under "Parts Replacement Procedures".

⚠ WARNING—SHOCK HAZARD ⚠

TROUBLESHOOTING MAY REQUIRE ACCESS TO HAZARDOUS LIVE CIRCUITS, AND SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL. MORE THAN ONE SWITCH MAY BE REQUIRED TO DE-ENERGIZE UNIT BEFORE SERVICING.

What's in this section?

The following topics are covered in this section.

Topic	See Page
9.1 Overview	219
9.2 Troubleshooting Aids	221
9.3 Power-up Tests	223
9.4 Status Tests	224
9.5 Background Tests	227
9.6 Controller Failure Symptoms	230
9.7 Troubleshooting Procedures	231
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Installation related problems

Read the Installation section in this manual to make sure the UDC5000 has been properly installed. The installation section provides information about protection against electrical noise, connecting external equipment to the controller, and shielding and routing external wiring.

ATTENTION System noise induced into the controller will result in diagnostic error messages recurring. If the diagnostic error messages can be cleared, it indicates a "soft" failure and is probably noise related.
If system noise is suspected, completely isolate the controller from all field wiring. Use calibration sources to simulate PV and check all controller functions; i.e. Gain, Rate, Reset, Output, Alarms, etc.

Application related problems

Review the application of the controller; then, if necessary, direct your questions to the local sales office.

Hardware and software related problems

Use the troubleshooting error message prompts and controller failure symptoms to identify typical failures which may occur in the controller. Follow the troubleshooting procedures to correct them.

9.2 Troubleshooting Aids

Overall error messages

An error message can occur

- at power-up
- during continuous background tests while in normal operation
- when the Status Tests are requested

Table 9-1 lists all the error message prompts that you could see, the reason for the failure, and under what test group the prompt could appear.

Refer to Tables 9-3 (Power-up), 9-5 (Status), and 9-6 (Background) for the particular test group indicated.

Table 9-1 Error Message Prompts

Error Message (lower display)	Reason for Failure	Test Group	Refer to Table
BATT LOW	Low Battery Voltage	Background	9-6
CAL TEST	Calibration test failure	Power-up or Status	9-3 9-5
CONF ERR	Low limit greater than high limit for PV, SP, Reset, or Output	Background	9-6
CFGTEST	Configuration data in controller in error	Power-up or Status	9-3 9-5
E E FAIL	Unable to write to non-volatile memory	Background	9-6
FACTEST	Factory Calibration Cyclic Redundancy test	Status	9-5
FAILSF	Controller in Failsafe	Power-up, Background, or Status	9-3 9-6 9-5
INP1FAIL **INP2FAIL** **INP3FAIL**	Two consecutive failures of Input integration	Background	9-6
INP1 RNG **INP2 RNG** **INP3 RNG**	Input Out of Range	Background	9-6
LOOPTEST	DMCS Loopback Test	Status	9-5
NV FAIL	Unable to write to RAM non-volatile memory	Background or Status	9-6 9-5
PV LIMIT	Derived PV Out of Range	Background	9-6
RAM TST	RAM test failed	Power-up or Status	9-3 9-5
RH LO	RH Excessive Temperature depression	Background	9-6
RV LIMIT	Remote Variable Out of Range	Background	9-6
SEG ERR	Start segment > ending segment	Background	9-6
SOOTING	%Carbon falls outside "SOOTING BOUNDARY"	Background	9-6

Continued on next page

Controller failure symptoms

Other failures may occur that deal with the Power, Output, or Alarms. Refer to the controller failure symptom in Table 9-7 to determine what is wrong and the troubleshooting procedures to use to correct the problem.

Check Installation

If a set of symptoms still persists, refer to *Section 2 - Installation* and ensure proper installation and proper use of the controller in the system.

Customer support

If you cannot solve the problem using the troubleshooting procedures listed in this section; get the **model number** and **serial number** and **software** version (see Table 9-2) then:

call Customer Support Phone Number

USA	1-800-423-9883
Canada	1-800-461-0013

If it is determined that a hardware problem exists and the controller is still within the two year warranty, a replacement controller or part will be shipped with instructions for returning the defective unit.

Determining the software version

Table 9-2 lists the procedure for identifying the software version number.

Table 9-2 Procedure for Identifying the Software Version

Step	Operation	Press	Action
1	Select STATUS Set Up Group	SET UP	Until you see: Upper Display READ Lower Display STATUS
2	Read the software version	FUNC	Until you see: Upper Display ← Software version Number Lower Display VERSION Please give this number to the Customer Support person. It will indicate which version of UDC5000 you have and help them determine a solution to your problem.

9.3 Power-up Tests

What happens at power-up

When the controller is powered-up, three tests are run by the UDC5000 software to ensure memory integrity.
As the tests are run, the displays will appear as shown in Table 9-3.

Table 9-3 Power-up Tests

Lower Display	Upper Display
RAM TEST	PASSED or FAILED
CONFTEST	PASSED or FAILED
CAL TEST	PASSED or FAILED

Test failures

If any of these three tests fail, "FAILSF" will appear momentarily in the upper display, then a display test is run, after which the controller will go into manual mode and you will see:

Upper Display
☐ ← PV value

Lower Display
FAILSAFE (blinking)

Refer to " *Subsection 9.4 -Status Tests*" to determine which tests have failed and how to correct them.

9.4 Status Tests

Introduction

When required, the results of these tests can be checked to determine the reason the controller has gone to "Failsafe".

How to check the status tests

The procedure in Table 9-4 tells you how to display the results of the status tests. Table 9-5 lists the tests, the reason for the failure, and how to correct the problem.

Table 9-4 Procedure for Displaying the Status Tests Results

Step	Operation	Press	Action
1	Select STATUS Set Up Group	SET UP	Until you see: Upper Display READ Lower Display STATUS
2	Read the status tests results	FUNC	Until you see: Upper Display NO or YES — YES indicates a failure Lower Display FAILSF Successive presses of the FUNC key will display the results of the status tests in the following order: NVTEST RAM TEST CFG TEST CAL TEST FACTEST LOOPTEST Identify the problem and correct the failure as shown in Table 9-5.

Continued on next page

Status Tests

Table 9-5 lists the Status tests, the reason for their failure, and how to correct the failure.

Table 9-5 Status Tests

Test (Lower Display)	Definition	Upper Display	Reason for Failure	How to Correct the Failure
FAILSAFE	Failsafe Fault	NO	No Failure	
FAILSF 2 (Loop 2)		YES	Burnout configured for none and input fails. –RAM TEST failed –CONFTEST failed –CALTEST failed	1. Step through the rest of the STATUS check to identify the particular failure. Press FUNC key and then step through all the status prompts a second time to verify if the particular failed code has cleared and shows "Passed". Also see Table 9-6, Background tests.
NVTEST	RAM Test	PASS	NO Failure	
		FAIL	Unable to write to RAM non-volatile memory	1. Step through the rest of the STATUS check to identify the particular failure. Press FUNC key.
RAM TEST	RAM test	PASS	No Failure	RAM test passed.
		FAIL	RAM Failure	1. Power cycle to see if the error clears.
CONF TEST	Configuration Checksum	PASS	No Failure	Configuration checksum passed.
		FAIL	Configuration data in the controller is in error.	1. Step through STATUS tests – the controller will recalculate the checksum. 2. Check all configuration prompts for accuracy. See *Section 3 - Configuration.*
CAL TEST	Working Calibration	PASS	No Failure	Working calibration checksum passed.
		FAIL	The working calibration constants in the controller are in error.	1. If the controller has not been field calibrated, see *Section 3 - Configuration* and change the input to a different type. Enter it, loop through the status tests, then return the input type to the original one. 2. If the controller has been field calibrated, recalibrate the controller.

Table 9-5 continued on next page

Status Test, continued

Table 9-5 Status Tests, continued

Test (Lower Display)	Definition	Upper Display	Reason for Failure	How to Correct the Failure
FACTTEST	Factory calibration test	PASS	No Failure	Factory calibration cyclic redundancy test passed
		FAIL	Factory set input constants have been changed due to the change in input type.	1. Cycle through Status to clear the error. 2. Check the calibration. Make sure 0 and 100% are correct values. 3. Recalibrate if step 1 is unsatisfactory. Refer to *Section 7-Input Calibration.*
LOOPTEST	DMCS Loopback Test	PASS	No Failure	Loopback Test passed.
		FAIL	Unable to communicate with the controller through DMCS	1. Check to see if the DMCS board • is installed properly • Jumpers are in W1 and W2 Position • transformer cable is connected at J10 2. Check the rear terminal wiring. See *Section 2 - Installation* for terminal designations.

9.5 Background Tests

Introduction

The UDC5000 performs on-going background tests to verify data and memory integrity. If there is a malfunction, an error message will be displayed (blinking) in the lower display.

Background Tests

In the case of more than one simultaneous malfunction, only the one with the highest priority will appear in the lower display. Table 9-6 lists these background tests, the reason for their failure, and how to correct the problem.

Table 9-6 Background Tests

Lower Display	Reason for Failure	How to Correct the Problem
BATT LOW	Low Battery Voltage Battery Voltage has fallen below 2.125Vdc.	1. Replace the battery.
EE FAIL	Unable to write to non-volatile memory. Anytime you change a parameter and it is not accepted, you will see EE FAIL.	1. Check the accuracy of the parameter and re-enter. 2. Try to change something in configuration. 3. Run through STATUS tests to re-write to EEPROM.
NVFAIL	Unable to write to RAM non-volatile memory.	1. Check the accuracy of the parameter and re-enter.
FAILSAFE	This error message shows whenever the controller goes into a failsafe mode of operation. This will happen if: • RAM test failed • Configuration test failed • Calibration test failed • Factory Calibration Checksum test failed	1. Run through STATUS check to determine the reason for the failure. 2. Press the SET UP key until STATUS appears in the lower display. 3. Press the FUNC key to see what tests pass or fail, then run through the STATUS codes a second time to see if the error cleared. 4. Correct according to the recommendations given in Table 9-5.
INP1FAIL **INP2FAIL**	Two consecutive failures of input integration. i.e., cannot make analog to digital conversion.	1. Make sure the input configuration and wiring is correct. 2. Make sure the cold junction resistor is attached to the rear terminals for thermocouple ranges. 3. Check for gross over-ranging. 4. Replace the cold junction resistor.
INP3FAIL	Two consecutive failures of input 3 integration. i.e., cannot make analog to digital conversion.	1. Make sure the actuation is configured correctly. See Section 3 - Configuration. 2. Make sure the input configuration and wiring is correct. 3. Make sure the 62.5 ohm resistor is attached to the rear terminals for input 3 range of 4–20mA. 4. Check for gross over-ranging.

Table 9-6 continued on next page

Table 9-6 Background Tests, continued

Lower Display	Reason for Failure	How to Correct the Problem
CONF ERR	• PV low limit is > PV high limit • SP low limit is > SP high limit • Reset low limit is > Reset high limit • Output low limit > Output high limit • Conflict between the Remote Mode switches and the input Algorithm selection.	1. Check the configuration for each item and reconfigure if necessary.
INP1 RNG **INP2 RNG** **INP3 RNG**	*Input out of range.* The process input is outside the range limits. *Input 3-* The remote input is outside the range limits for 4 to 20 mA or 1 to 5 Volts dc. ATTENTION If the range goes outside the range limits, the controller will switch to Manual and the configured Failsafe output value.	1. Make sure the range and actuation are configured properly. 2. Check the input source. 3. If the controller has not been field calibrated, see *Section 3 - Configuration* and change the input to a different type. Enter it, loop through the status tests, then return the input type to the original one. 4. If the controller has been field calibrated, recalibrate the controller.
PV LIMIT	A. PV out of range. PV = INP1 + INP1 BIAS B. Second input algorithm selection (for example: Carbon Potential) does not permit Remote Switching parameter selection of PVIN2 or PVIN3.	A1. Make sure the input signal is correct. A2. Make sure the Bias setting is correct A3. Recheck the calibration. Use Bias of 0.0 B1. Reconfigure the second Input algorithm.
RHLO	RH Excessive Temperature Depression when calculated %RH is less than 0%.	1. Make sure the range and actuation are configured properly. 2. Check the input source. 3. If the controller has not been field calibrated, see *Section 3 - Configuration* and change the input to a different type. Enter it, loop through the status tests, then return the input type to the original one. 4. If the controller has been field calibrated, recalibrate the controller.
RV LIMIT	The result of the formula shown below is beyond the range of the remote variable. RV = (INP2 X RATIO) + BIAS	1. Make sure the input signal is correct. 2. Make sure the Ratio and Bias settings are correct. 3. Recheck the calibration. Use a Ratio of 1.0 and a Bias of 0.0.

Continued on next page

Table 9-6 Background Tests, continued

Lower Display	Reason for Failure	How to Correct the Problem
SEG ERR	The start segment number is greater than the ending segment number.	1. Reconfigure - make start segment number less than end segment number..
SOOTING	Percent Carbon falls outside "SOOTING BOUNDRY".	1. Make sure the range and actuation are configured properly. 2. Check the input source. 3. If the controller has not been field calibrated, see *Section 3 - Configuration* and change the input to a different type. Enter it, loop through the status tests, then return the input type to the original one. 4. If the controller has been field calibrated, recalibrate the controller.

9.6 Controller Failure Symptoms

Introduction

In addition to the error message prompts, there are failure symptoms that can be identified by noting how the controller displays and indicators are reacting.

Symptoms

Compare your symptoms with those shown in Table 9-7 and refer to the troubleshooting procedure indicated to correct the problem.

Table 9-7 Controller Failure Symptoms

Upper Display	Lower Display	Indicators	Controller Output	Probable Cause	Trouble-shooting Procedure
Blank	Blank	Off	None	Power Failure	1
OK	Displayed Output disagrees with Controller Output	OK	Controller Output disagrees with Displayed Output	Current Proportional Output	2
OK		OK		Time(Relay) Proportional Output	3
OK		OK		Position Proportional Output	4
OK		OK		Current/Time Proportional Output	5
OK	OK	OK	External Alarm function does not operate properly	Malfunction in alarm output	6
Display does not function when a key is pressed				Keyboard Malfunction	7
Controller fails to go into "Slave" operation during communications				Communications Failure	8

Other symptoms

If a set of symptoms or prompts other than the one you started with appears while troubleshooting, re-evaluate the symptoms. This may lead to a different troubleshooting procedure.
If the symptom still persists, refer to the installation section in this manual to ensure proper installation and proper use of the controller in your system.

9.7 Troubleshooting Procedures

Introduction

The troubleshooting procedures are listed in numerical order as they appear in Table 9-7. Each procedure lists what to do if you have that particular failure and how to do it or where to find the data needed to accomplish the task.

Equipment needed

You will need the following equipment in order to troubleshoot the symptoms listed in the tables that follow:

- DC Milliammeter – mAdc
- Calibration sources – T/c, mV, Volt, etc.
- Voltmeter

Procedure #1

Table 9-8 explains how to troubleshoot power failure symptoms.

Table 9-8 Troubleshooting Power Failure Symptoms

Step	What to do	How to do it
1	Check the AC line voltage.	Use a Voltmeter to measure the AC voltage across terminals L1 and L2 on the rear terminal panel of the controller. Check the earth ground connection.
2	Make sure the chassis plugs into the rear of the case properly.	Withdraw the chassis and visually inspect the main printed wiring board and the inside of the case.
3	Check the Voltage selection.	See if the Power Select Jumper on the main printed wiring board is in the proper position for the Voltage being used. Refer to Section 2 - *Installation.*
4	Check the system for Brown-outs, heavy load switching, etc.; and conformance to installation instructions.	Refer to *Section 2 - Installation.*

Continued on next page

Procedure #2

Table 9-9 explains how to troubleshoot Current Proportional Output failure symptoms.

Table 9-9 Troubleshooting Current Proportional Output Failure

Step	What to do	How to do it
1	Make sure the controller is configured for Current output.	Make Set Up group prompt "OUT ALG". Function prompt "OUT ALG" = selection "CURRENT" Refer to *Section 3 - Configuration.*
2	Check the field wiring.	Output impedance must be less than or equal to 1000 Ohms.
3	Make sure all the configurable tuning constants, limits, and configuration data stored in the controller are correct. Reconfigure, if necessary.	Refer to *Section 3 - Configuration* to check all this data and how to reconfigure.
4	Check the output.	Press the LOWR DISP key until you see OUT in the Lower Display. Change the output from 0 to 100% (4-20 mA). Use a DC milliammeter at the rear terminals to verify the output. 4–20mA output corresponds to an output of 0 to 100%.
5	Recalibrate the Current Proportional Output.	Refer to *Section 8 - Output Calibration* for details.

Continued on next page

Procedure #3

Table 9-10 explains how to troubleshoot Time Proportional Relay Output(s) failure.

Table 9-10 Troubleshooting Time Proportional Relay Output(s) Failure

Step	What to do	How to do it
1	Make sure the controller is configured for Time Proportional or Time Proportional Duplex output.	Make Set Up group prompt "OUT ALG". Function prompt "OUT ALG" = selection is "TIME" or "TIME D whichever is required. Refer to *Section 3 - Configuration.*
2	Check the field wiring.	See *Section 2 - Installation* for wiring diagrams.
3	Make sure all the configurable tuning constants, limits, and configuration data stored in the controller are correct. Reconfigure, if necessary.	Refer to *Section 3- Configuration* to check all this data and how to reconfigure.
4	Check that the applicable output relay actuates properly per the controller output value.	• Vary the setpoint around the PV. Listen for the click of the relay as the setpoint moves in either direction. Observe OUT1 or 2 light on the operator interface.
5	Check the Output (control) relay contact selection.	• Refer to *Section 2 - installation* for Relay contact information.

Continued on next page

Procedure #4

Table 9-11 explains how to troubleshoot Time/Current or Current/Time Proportional Relay Output(s) failure.

Table 9-11 Troubleshooting Time/Current or Current/Time Proportional Relay Output(s) Failure

Step	What to do	How to do it
1	Make sure the controller is configured for Time/Current or Current/Time Proportional output.	Make Set Up group prompt "OUT ALG". Function prompt "OUT ALG" = selection is "CUR TI" or "TI CUR whichever is required. Refer to *Section 3 - Configuration.*
2	Make sure all the configurable tuning constants, limits, and configuration data stored in the controller are correct. Reconfigure, if necessary.	Refer to *Section 3- Configuration* to check all this data and how to reconfigure.
3	Check that the applicable output relay actuates properly per the controller output value.	• Vary the setpoint around the PV. Listen for the click of the relay as the setpoint moves in either direction. Observe OUT1 or 2 light on the operator interface.
4	Check the Output (control) relay contact selection.	• Refer to *Section 2 - installation* for Relay contact information.
5	Check the Current Proportional Output.	• Put the controller into manual mode and vary the output from 0 to 100% (4–20mA). Use a DC millammeter at the rear terminals to verify the output.
6	Recalibrate the controller.	Refer to *Section 8 - Output Calibration* for details.

Continued on next page

Procedure #5

Table 9-12 explains how to troubleshoot Position Proportional Relay Output(s) failure.

Table 9-12 Troubleshooting Time/Current or Current/Time Proportional Relay Output(s) Failure

Step	What to do	How to do it
1	Make sure that the Position Proportional printed wiring board is installed properly.	• Pull the chassis from the case and visually inspect the board. See *Section 10 - Parts List* for location.
2	Make sure the controller is configured for Position Proportional output.	Make Set Up group prompt "OUT ALG". Function prompt "OUT ALG" = selection "POSITN" Refer to *Section 3 - Configuration.*
3	Check the field wiring.	See *Section 2 - Installation* for wiring diagrams.
4	Check the Output.	• Put the controller into manual mode and vary the output from 0 to 100% .
5	Check whether the motor drives in both directions. If the motor drives in one direction, check the slidewire. If the motor does not drive in either direction, check the motor.	•Refer to the Position Proportional Calibration procedure in *Section 8 - Output Calibration* for motor slidewire calibration. •Refer to the motor instructions.
6	Check the Voltage output to the slidewire.	• Should equal 1.34 to 1.04 Volts. See *Section 2 - Installation* for terminal designations. The feedback slidewire output voltage must vary with the valve position. If not, recalibrate using "AUTO" mode and check again.
7	Make sure that the output relays are actuating properly. If they are not, check the field wiring then go to step 6. If they are, go to step 8.	• Place the controller into manual mode. Vary the output above and below the present value. Listen for the click of the relays. One relay should click when the output is moved higher, and the other should click when the output is moved lower than the present setting. Observe OUT 1 and 2 on the operator interface.
8	Check the Output (control) relay contact selection.	• Refer to *Section 2 - installation* for Relay contact information.
9	Replace the Position Proportional printed wiring board	• Refer to the "Replacement Procedures" in this section.
10	Recalibrate the controller.	Refer to *Section 8 - Output Calibration* for details.

Continued on next page

Procedure #6

Table 9-13 explains how to troubleshoot Alarm Relay Output(s) failure.

Table 9-13 Troubleshooting Alarm Relay Output(s) Failure

Step	What to do	How to do it
1	Check the alarm configuration data. If it is correct, check the field wiring.	Reconfigure if necessary. Refer to *Section 3 - Configuration* for details.
2	Check that the applicable alarm relay actuates properly. It depends on what you have set at "ALARMS" group prompt "AxSxTYPE". If it does, check the field wiring.	If the alarm type is set for PV, place the controller in manual mode. Vary the input to raise and lower the PV around the setpoint. Note that the proper annunciators flash. If the alarm is set for OUTPUT, put the controller into manual mode. Raise or lower the output above or below the value you have set as the alarm setpoint. Note that the proper annunciators flash. Check for proper continuity when the alarm actuates.
3	Check the Output (alarm) relay contact selection.	• Refer to *Section 2 - installation* for Alarm relay contact information.

Continued on next page

Procedure #7

Table 9-14 explains how to troubleshoot a Keyboard failure.

Table 9-14 Troubleshooting a Keyboard Failure

Step	What to do	How to do it
1	Make sure the keyboard is connected properly to the Display board.	Withdraw the chassis from the case and visually inspect the connection.
2	Controller Keyboard may be "LOCKED OUT" via the security code.	Use your 4 digit security code number to change the lockout level. Refer to *Section 3 – Configuration.* **ATTENTION** Using "1000" as a security code number will override the 4-digit code previously entered.
3	Run the keyboard test.	Press the SET UP key and hold in, then press the FUNC key at the same time. The controller will run a display test. Then you will see: Upper Display KEYS Lower Display TRY ALL Press each key. If it works, the key name will appear in the lower display.
4	Replace the keyboard if any keys are shorted out.	Refer to *"Parts Replacement Procedures"* in this section.

Continued on next page

9.7 Troubleshooting Procedures, Continued

Procedure #8

Table 9-15 explains how to troubleshoot a Communications failure.

Table 9-15 Troubleshooting a Communications Failure

Step	What to do	How to do it
1	Check the field wiring and termination resistor.	Depending on the protocol used, refer to the proper Communications Manual Installation Section.
2	Make sure the Communications Printed Wiring Board is installed properly in the controller.	Withdraw the chassis from the case and inspect the board. See the exploded view (Figure 10-1) for location of the board. Return the chassis to the case.
3	Determine if the Communications board is faulty by running a LOCAL LOOPBACK TEST. If the test fails, replace the board.	Run the Local Loopback Test. Press SET UP until you see: Upper Display SET UP Lower Display COM Press FUNC until you see: Upper Display DISABL Lower Display LOOPBACK Press ▲ or ▼, you will see: Upper Display Enable Lower Display LOOPBACK **The test will run until the operator disables it here.**

9.8 Parts Replacement Procedures

Introduction

These procedures tell you how to access and replace the following printed wiring boards in your controller.

- Keyboard and/or Display Board
- Parts on the Controller Board
  - Battery
  - PROM
  - Control Relays
- Auxiliary Output/Remote Mode Switching Option Board
- Second Input Board
- Communications Option Board
- Controller Board
- Transmitter Power Board

Figure 9-1 shows you how to remove the chassis from the case.

Figure 9-2 identifies all the Printed Wiring Boards and parts necessary to facilitate removing and replacing the Parts listed above.

Equipment needed

To accomplish the procedures that follow, you will need the following equipment:

- Phillips Head Screwdriver
- Flat Bladed Screwdriver
- Small Pliers

Continued on next page

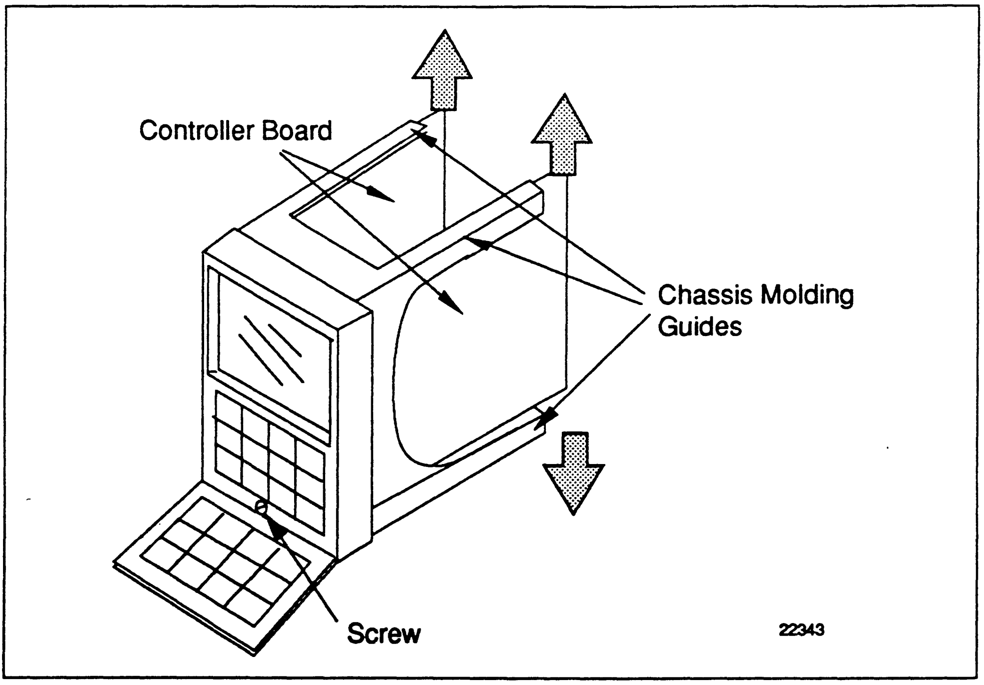
How to remove the chassis and controller board

Refer to Figure 9-1 for steps and follow the procedure listed in Table 9-16.

Table 9-16 How to Remove the Chassis and Controller Board

Step	Action
1	Pull down the front door and loosen the screw.
2	Grasp the bezel and pull the chassis out of the case.
3	Spread the top and bottom chassis moulding guide railings to dislodge the controller board notches from their locks.
4.	Pull on the controller board and slide it out. The board will unplug from the display board.

Figure 9-1 Chassis and Controller Board Removal



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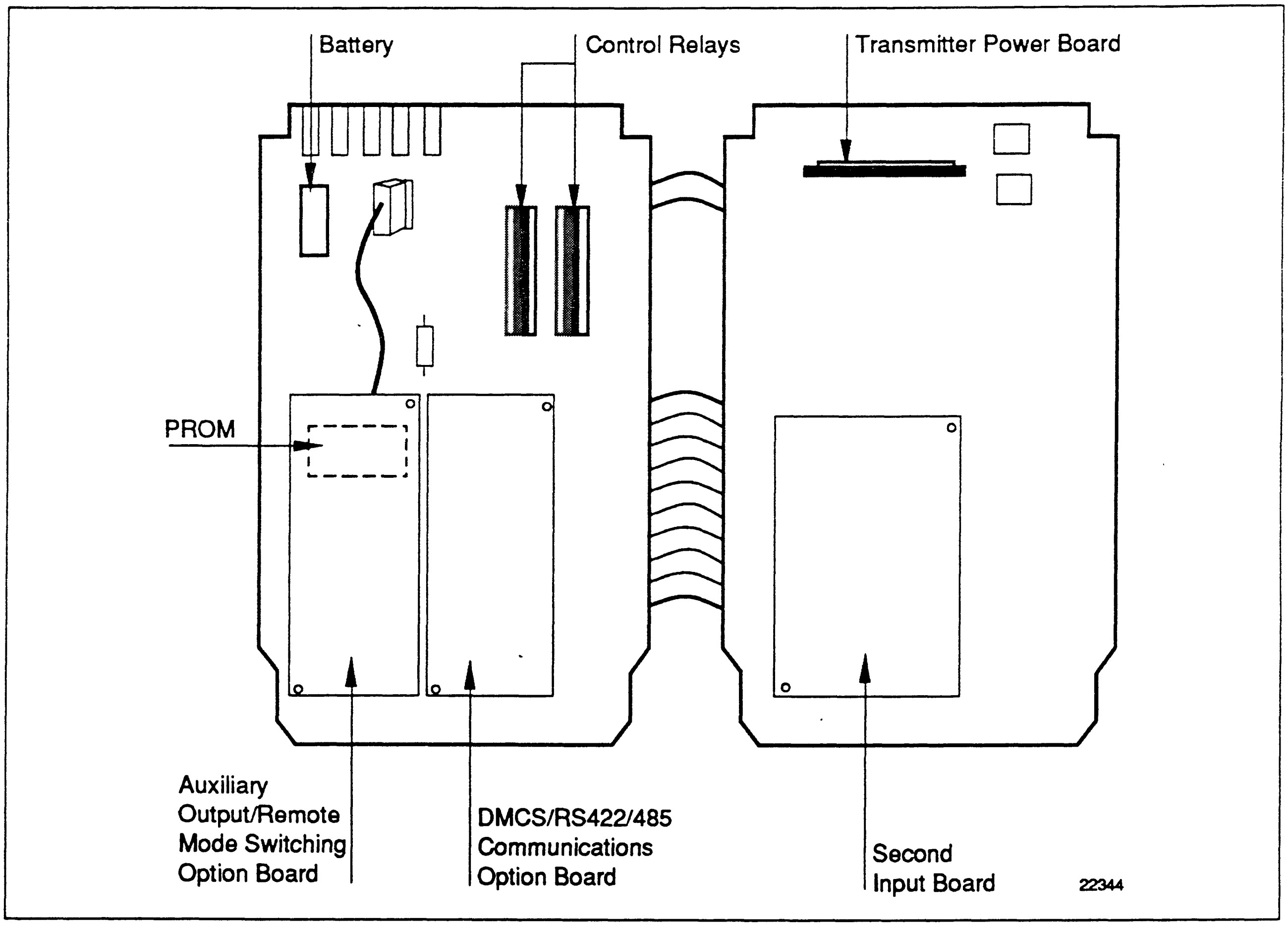
Parts and printed wiring board identification Figure 9-2 identifies all the Parts and Printed Wiring boards located on the Controller Printed Wiring Board.

Figure 9-2 Controller Parts and Printed Wiring Boards Identification


Battery
Control Relays
Transmitter Power Board
PROM
Auxiliary Output/Remote Mode Switching Option Board
DMCS/RS422/485 Communications Option Board
Second Input Board
22344

Continued on next page

How to replace the Battery, PROM, or Control Relays

Refer to Figure 9-2 for parts location and follow the procedures in Table 9-17 to replace the Battery, PROM, or Control Relays.

Table 9-17 Battery, PROM, or Control Relay Replacement Procedures

Step	Action
1	Remove the chassis from the case as shown in Figure 9-1.
2	Remove the controller board from the chassis as shown in Figure 9-1.
3	Disassemble the controller board from the thermal barrier and lay the board out on a static free flat surface.
BATTERY	
1	Unsolder the old battery and solder the new battery into place. **ATTENTION** If you have Setpoint Programming option, reconfigure the parameters (See Section 6 - Setpoint Ramp/Soak Programming).
PROM	
1	Remove the Auxiliary Output/Remote mode switching option board. Refer to Figure 9-2 for location and Table 9-18 for procedure.
2	Replace the PROM. Make sure the PROM is oriented properly.
3	Replace the Auxiliary Output/Remote Mode Switching option board.
CONTROL RELAYS	
1	Push the clip off the control relay and pull the relay out of the socket.
2	Install the new relay and replace the clip.

Continued on next page

How to replace the auxiliary output/remote mode switching option board

Refer to Figure 9-2 for parts location and follow the procedures in Table 9-18 to replace the Auxiliary Output/Remote Mode Switching Option board.

Table 9-18 Auxiliary Output/Remote Mode Switching Option board Replacement Procedures

Step	Action
1	Remove the cable if present at J12 on the option board.
2	Remove the two screws on the other side of the controller board that hold the option board in place and pull the board up.
3	Make sure jumpers W1, W2, W3, W4, and W5 are in the same position as on the old board. Install W3, W4, W5 for *Remote Mode Switching* or *Auxiliary Output and Remote mode Switching* Install W1, W2 for *Auxiliary Output* or *Auxiliary Output and Remote Mode Switching* ATTENTION **DO NOT install for Auxiliary Output, Remote Mode Switching, and Communications (Use the Cable to J12)** Install W3 and RMS cable for *Communications* and *Remote Mode Switching.*
4	Install the new option board using the same screws.
5	Reattach connector J12 if present.

Continued on next page

How to replace the communications option board.

Refer to Figure 9-2 for parts location and follow the procedures in Table 9-19 to replace the Communications Option board.

Table 9-19 Communications Option board Replacement Procedures

Step	Action
1	Remove the two screws on the other side of the controller board that hold the Communications Option board in place and pull the board up.
2	Position jumpers W1 and W2 in the same position as the old board: Install W1 and W2 for *Communication* and *Auxiliary Output Option* or *NO option.*
3	Instal the new Communications board using the same screws.

Continued on next page

How to replace the second input board

Refer to Figure 9-2 for parts location and follow the procedures in Table 9-20 to replace the Second Input board.

Table 9-20 Second Input board Replacement Procedures

Step	Action
1	Remove the two screws on the other side of the controller board that hold the second input board in place, and pull the board up.
2	Position W1/W2 jumper the same as on the old board: **W2** position for *Carbon Potential* **W1** position for *all other selections*
3	Install the new second input board using the same screws.
4	Factory calibration constants will be approximate. Check the calibration. If incorrect, recalibrate.

Continued on next page

How to replace the controller printed wiring board

To replace the Controller printed wiring board follow the procedure listed in Table 9-21. Figure 9-3 shows all the Jumpers and their locations.

Table 9-21 Controller Board Replacement Procedure

Step	Action
1	Remove the chassis from the case as shown in Figure 9-1.
2	Remove the controller board from the chassis as shown in Figure 9-1.
3	Disassemble the controller board from the thermal barrier and lay the board out on a static free flat surface.
4	Remove all the option boards as shown in Table 9-18, 9-19, and 9-20. Make sure all the jumpers are in the same position as on the original controller board. Refer to Figure 9-3 for jumper locations.
5	Install the option boards removed from the old board onto the new controller board.
6	Reassemble the heat shield to the controller board.
7	Slide the controller board into the chassis guide molding and push into place.
8	Return the chassis to the case and tighten the screw.

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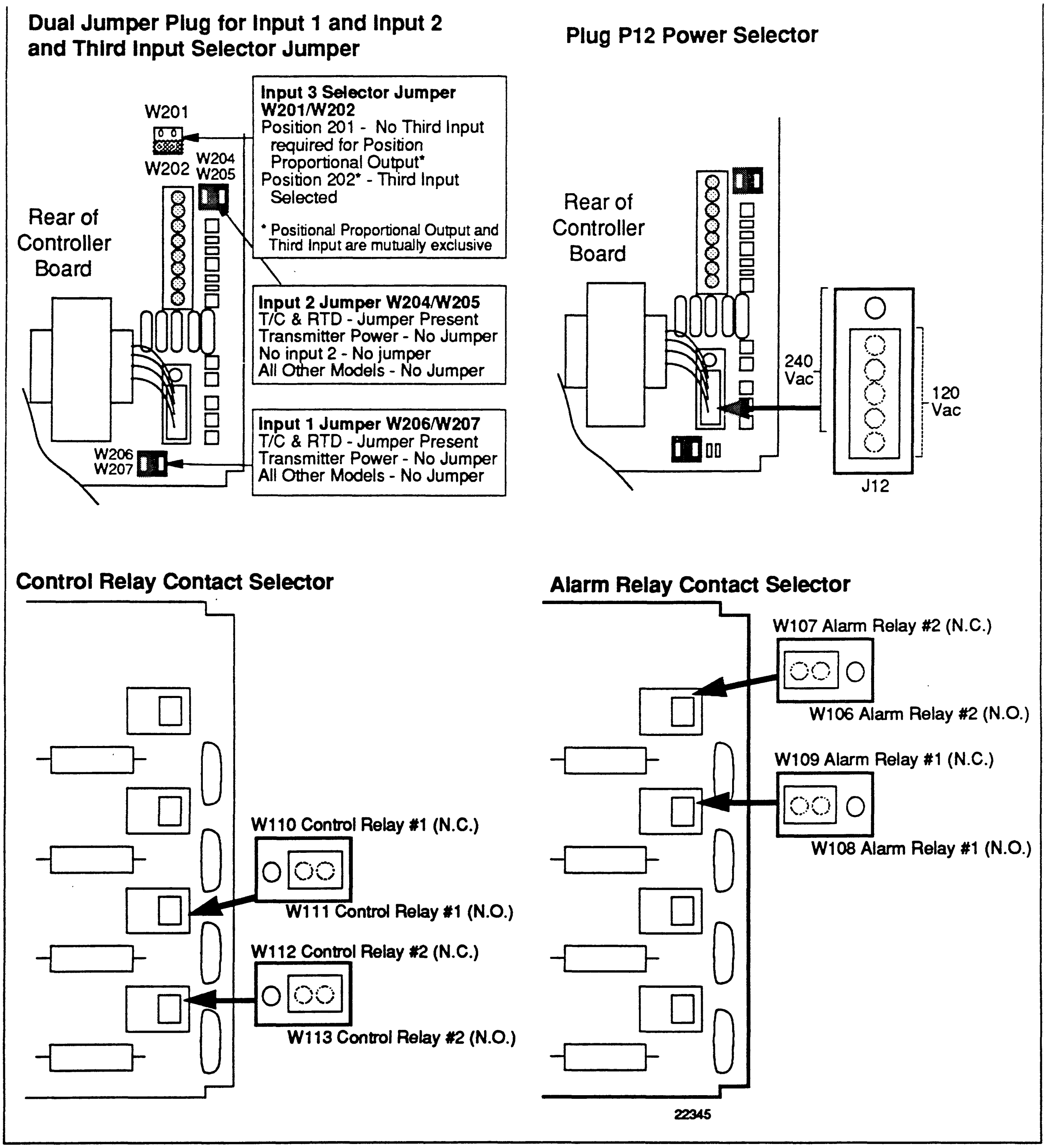
How to replace the controller printed wiring board

Figure 9-3 shows the location of the Jumper locations on the controller board.

Figure 9-3 Controller Board Jumper Locations



Dual Jumper Plug for Input 1 and Input 2 and Third Input Selector Jumper

Input 3 Selector Jumper W201/W202
Position 201 - No Third Input required for Position Proportional Output*
Position 202* - Third Input Selected

* Positional Proportional Output and Third Input are mutually exclusive

Input 2 Jumper W204/W205
T/C & RTD - Jumper Present
Transmitter Power - No Jumper
No input 2 - No jumper
All Other Models - No Jumper

Input 1 Jumper W206/W207
T/C & RTD - Jumper Present
Transmitter Power - No Jumper
All Other Models - No Jumper

Plug P12 Power Selector

Control Relay Contact Selector

Alarm Relay Contact Selector

W201
W202
W204
W205
Rear of Controller Board
W206
W207
Rear of Controller Board
240 Vac
120 Vac
J12
W110 Control Relay #1 (N.C.)
W111 Control Relay #1 (N.O.)
W112 Control Relay #2 (N.C.)
W113 Control Relay #2 (N.O.)
W107 Alarm Relay #2 (N.C.)
W106 Alarm Relay #2 (N.O.)
W109 Alarm Relay #1 (N.C.)
W108 Alarm Relay #1 (N.O.)
22345

Continued on next page

How to replace the transmitter power printed wiring board

To replace the Transmitter Power printed wiring board, refer to Figure 9-4 for Jumper locations and follow the procedure listed in Table 9-22.

Table 9-22 Transmitter Printed Wiring Board Replacement Procedure

Step	Action
1	Remove the chassis from the case as shown in Figure 9-1.
2	Place the chassis on a clean, static-free work surface, right side down. The Transmitter power board plugs into the controller board at the rear.
3	Configure the new Transmitter Power board to provide power to the particular input circuit that you intend to use. Install the cowbell jumpers across the appropriate pins on the new power bower board to match the jumpers on the old board. Refer to Figure 9-6 for location of jumpers. **TRANSMITTER POWER** — **JUMPER POSITIONS** Input 1 only — W3 and W4 Input 2 or Input 3 — W1 and W2 Input 1, 2, and 3 — W1, W2, W3, W4 Disable Inputs — Remove all jumpers
4	Remove the old transmitter power board from connector J6 at the rear of the right-hand portion of the controller board and insert the new one. Make sure the new board snaps into place.
5	Locate and check the two dual jumper positions identified as W206/W207 and W204/W205, at the rear of the right-hand portion of the controller board. The jumpers are correctly positioned when the white lines are vertical. See Figure 9-6 for proper position.
6	Locate and check the jumper for Input 3 selection identified as W201/W202. Refer to Figure 9-4 for proper position.
7	Reinstall the chassis in the case and turn the screw on the front of the controller clockwise until the chassis is secured in place.
8	Check the field wiring. **a**. Check the connections of the 2-wire transmitter(s) to the input terminals at the rear of the case. External wiring diagrams for the various types of outputs are contained in the installation section. **b**. Apply power to the controller.

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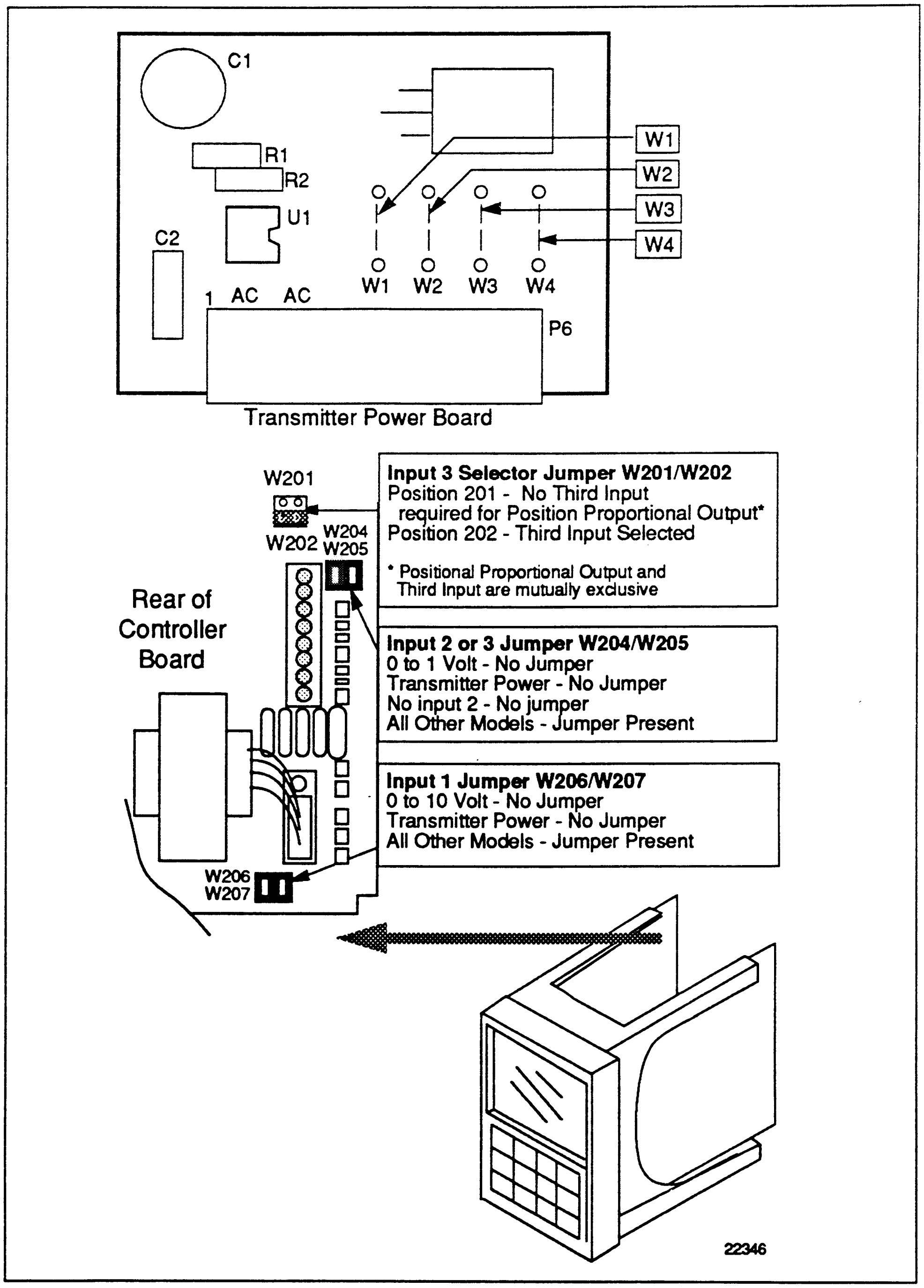
How to replace the transmitter power printed wiring board

Figure 9-4 Transmitter Power Board Jumper Locations



Input 3 Selector Jumper W201/W202
Position 201 - No Third Input required for Position Proportional Output*
Position 202 - Third Input Selected

* Positional Proportional Output and Third Input are mutually exclusive

Input 2 or 3 Jumper W204/W205
0 to 1 Volt - No Jumper
Transmitter Power - No Jumper
No input 2 - No jumper
All Other Models - Jumper Present

Input 1 Jumper W206/W207
0 to 10 Volt - No Jumper
Transmitter Power - No Jumper
All Other Models - Jumper Present

Continued on next page

How to replace the keyboard or display printed wiring board

To replace the Keyboard or Display printed wiring board, refer to Figure 9-7 and follow the procedure listed in Table 9-23.

Table 9-23 Keyboard or Display Printed Wiring Board Replacement Procedure

Step	Action
1	Remove the chassis from the case as shown in Figure 9-1.
2	Remove the controller board from the chassis molding as shown in Figure 9-1.
KEYBOARD	
1	Remove the door. Pull on one side of the bezel and slide the nub on the door up, out of place.
2	Disconnect the cable attached to the rear of the display board. Refer to Figure 9-5.
3	Spread the side of the bezel and insert a small screwdriver under a lower corner of the keyboard and pry out from the bezel. Refer to Figure 9-5.
4	Insert the new keyboard, sliding the cable through the opening in the display board and push the keyboard into place.
5	Make the connection at the rear of the display board.
DISPLAY BOARD	
1	Remove the keyboard as shown above.
2	Grasp the bezel with each thumb on the inside. Pull on each side of the bezel and push the display board out with your fingers from behind. Refer to Figure 9-5.
3	Position the new display board and snap into place.
4	Replace the keyboard as shown.

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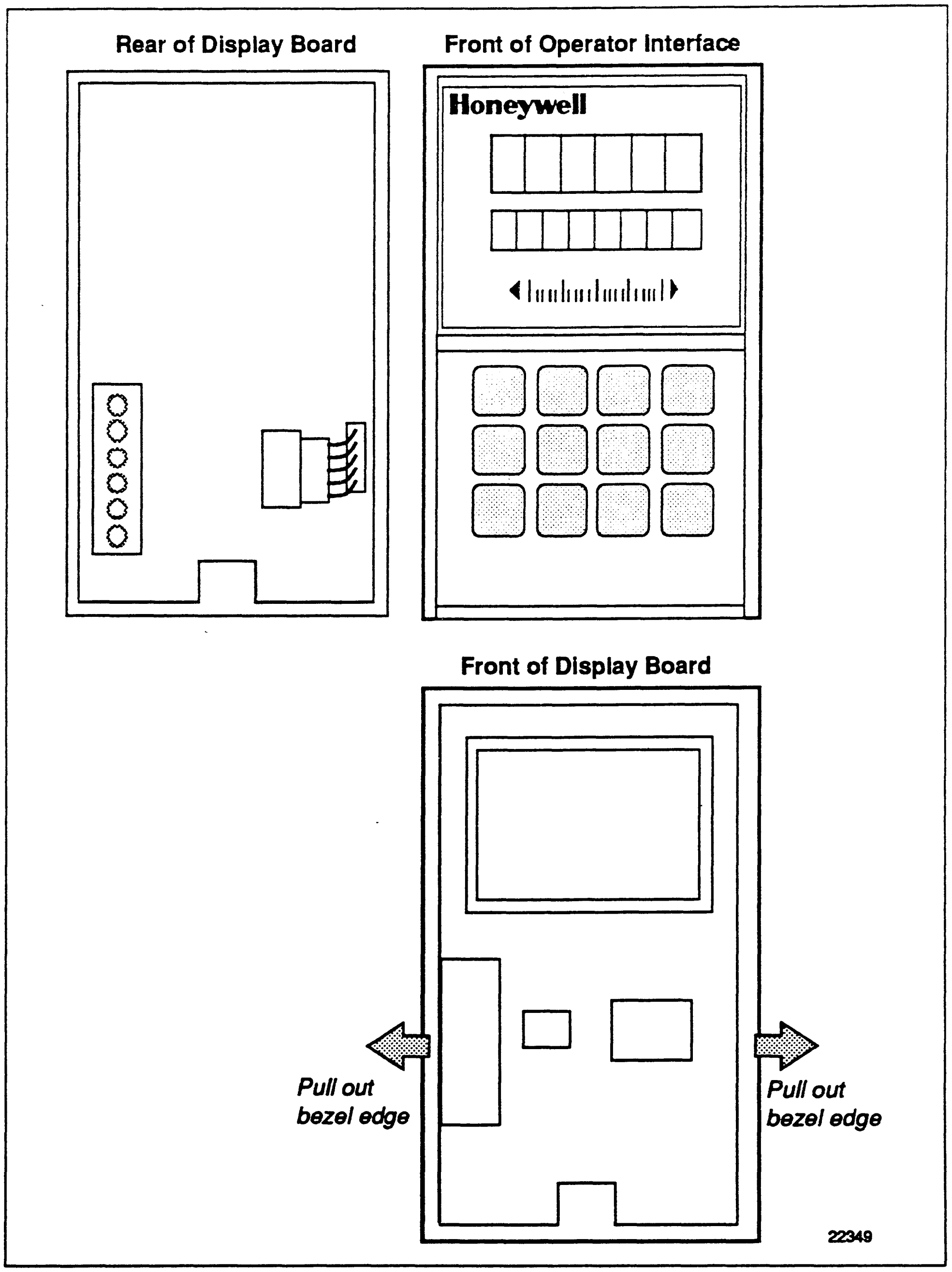
How to replace the keyboard or display printed wiring board, continued

Figure 9-5 Keyboard or Display Printed Wiring Board Replacement



9.9 Maintenance

Cleaning

If you find it necessary to clean the elastomer bezel, use an alcohol solution of 50% or less or mild soapy water.

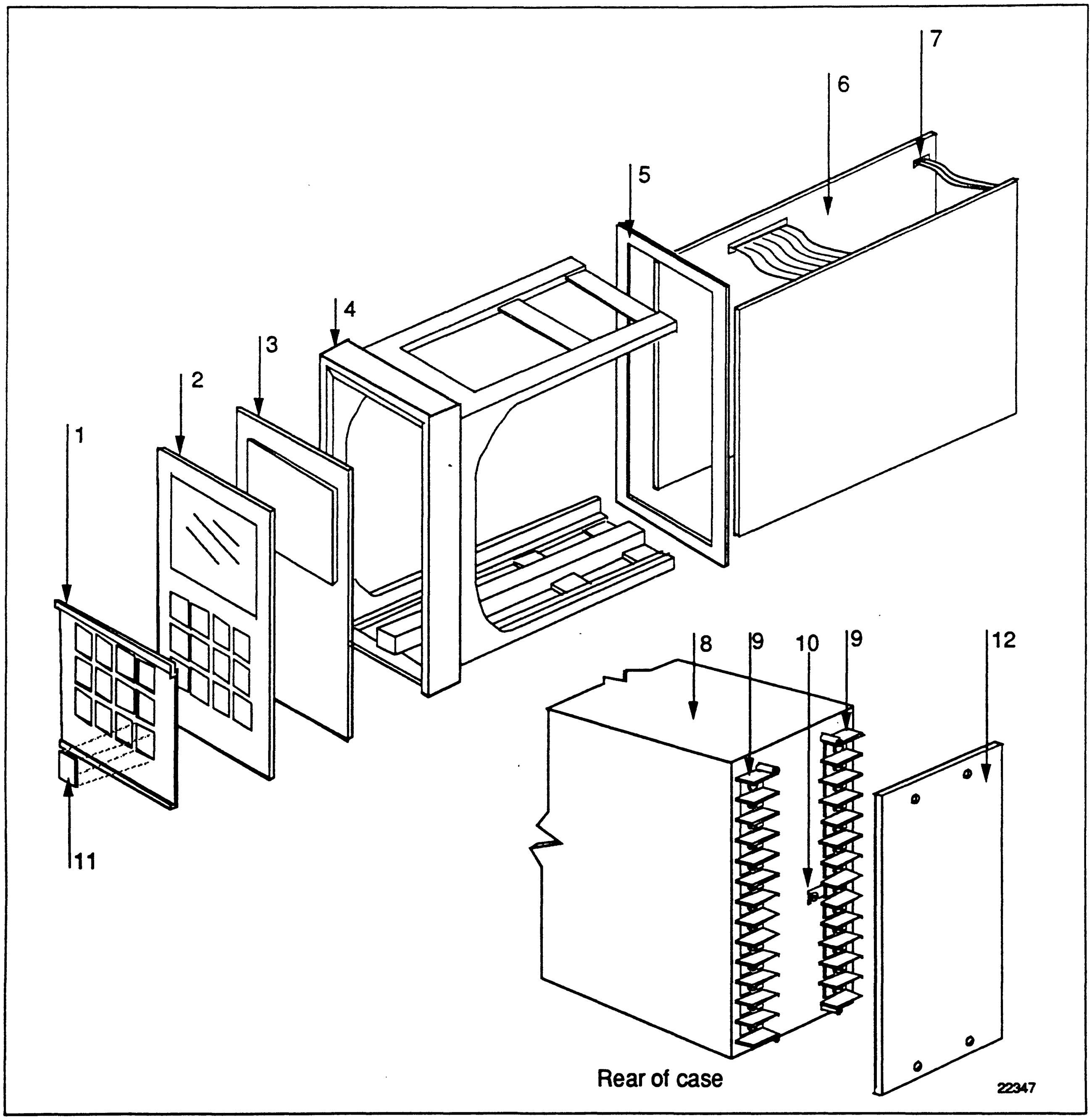
Section 10 – Parts List

10.1 Exploded View

Introduction

Figure 10-1 is an exploded view of the UDC5000 Controller. Each part is labeled with a key number. The part numbers are listed by key number in Table 10-1. There is a list of parts not shown in Table 10-2.

Figure 10-1 UDC5000 Exploded View



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Parts Identification

Table 10-1 lists the part numbers for the key numbers shown in the exploded view.

Table 10-1 Parts Identification

Key Number	Part Number	Description	Quantity
1	K30756035-501* K30756035-502*	Door (blue color) Door (gray color)	1
2	30755404-501 30755404-502	Keyboard Assembly - blue Keyboard Assembly - gray	1
3	30755399-501	Display Printed Wiring Board	1
4	K30756035-501* K30756035-502*	Chassis Molding - blue Chassis Molding - gray	1
5	30755858-501	Rubber Gasket	1
6	See Table 10-2	Controller Printed Wiring Board	1
7	K30756035-501* K30756035-502*	Thermal Barrier - blue Thermal Barrier - gray	1
8	K30756035-501* K30756035-502*	Case - blue Case - gray	1
9	30754499-003	Rear Connector (terminal) Kit (1 per kit)	2
10	K30756035-501* K30756035-502*	Ground Strap - blue Ground Strap - gray	1
11	K30756035-501* K30756035-502*	Button Molding Kit (12 buttons per kit) - blue Button Molding Kit (12 buttons per kit) - gray	1
12	30754494-001	Rear Cover Kit	1

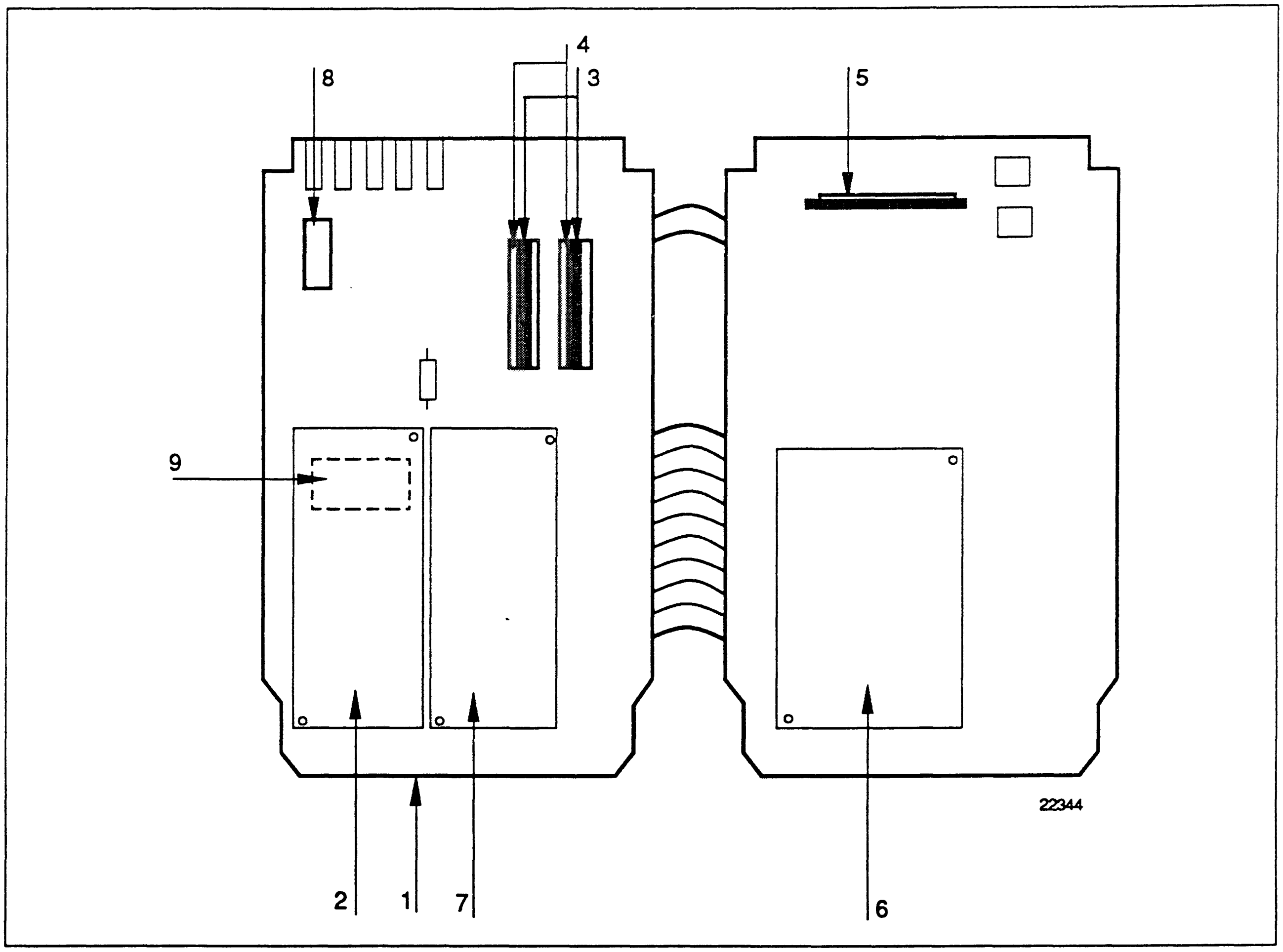
* Kit 30756035-501 also contains mounting hardware not shown.

Continued on next page

Introduction

Figure 10-2 is a view of the Controller Printed Wiring Board. Each part is labeled with a key number. The part numbers are listed by key number in Table 10-2. There is a list of parts not shown in Table 10-3.

Figure 10-2 Controller Wiring Board Parts



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Parts Identification

Table 10-2 lists the part numbers for the key numbers shown in Figure 10-2.

Table 10-2 Controller Printed Wiring Board Parts

Key Number	Part Number	Description	Quantity
1		Controller Printed Wiring Board	1
	30755393-502	Current Output	
	30755393-503	Time, Current Time Duplex, Position or Universal Outputs	
2	30755402-501	Auxiliary Output / Remote Mode Switch Printed Wiring Board	1
3	K30754499-005	Output Relay Hold down (2 per kit)	2
4	K30754499-005	Output Relay (2 per kit)	2
5	30754385-501	Transmitter Power PWB	1
6	30755851-501	Second Input Printed Wiring Board	1
7	30755408-501	DMCS Communications Printed Wiring Board	1
	30755865-502	RS422/485 Communications Printed Wiring Board	
8	30750596-501	Battery	1
9		**PROM - 28 pins** Memory Upgrade Kits (all include Communications)	1
	30756133-501	Autotune + Input 3	
	30756134-501	Autotune + Input 3 + Setpoint Program/Math	
	30756135-501	2 Loops PID + Autotune + Input 3	
	30756136-501	2 Loops + Autotune + Input 3 + Setpoint Program/Math	
		PROM - 32 pins Memory Upgrade Kits (all include Communications)	
	30756550-501	Autotune + Input 3	
	30756551-501	Autotune + Input 3 + Setpoint Program/Math	
	30756552-501	2 Loops PID + Autotune + Input 3	
	30756553-501	2 Loops + Autotune + Input 3 + Setpoint Program/Math	

Continued on next page

Parts not shown

Table 10-3 lists the part numbers of the parts not show in Figures 10-1 and 10-2.

Table 10-3 Parts Not Shown

Part Number	Description	Quantity
30754466-501	4–20 mA Resistor Assembly (62.5 ohms)	1
30754465-501	0–10 Volt Input Resistor Network	1
30757088-501	Cold Junction Resistor Kit	1*
30732481-502	Single Metal Oxide Resistor	1
30754499-004	Fuse Kit	1
30754471-501	Universal Input Kit	1
30755946-501	Third Input 1 to 5 Volt dc Interface Board	1
30756013-501	Single Solid State Relay Assembly - 2 Amp	1
30756016-501	Dual Solid State Relay Assembly - 2 Amps	2 relays
30756018-502	Single Solid State Relay Assembly - 10 Amp	1
30752640-001	Adapter Plate	1
30755050-001	Mounting Kit (2 brackets)	1
30754499-001	Jumper Kit	1
30756214-501	Open Collector Adapter	1

Appendix A – Manual Tuning

A.1 Overview

Introduction

When you tune a controller, there are some things to consider:

- Process Characteristics - Gain, Time Constants, etc.
- Desired response - Minimal overshoot

Basically, controller tuning consists of determining the appropriate values for the Gain (PB), Rate (Derivative), and Reset (Integral) time tuning parameters (control constants) that will give the control you want. Depending on the characteristics of the deviation of the process variable from the setpoint, the tuning parameters interact to alter the controller's output and produce changes in the value of the process variable.

Since each parameter responds to a specific characteristic of the deviation, you may not need a combination of all three. It depends on the process characteristics and the desired control response.

Tuning technique

You can estimate a starting point and the tuning parameters required to give the desired controller response and with some experience become proficient with this method.

An alternate approach is to rely on a tuning technique. In practice, tuning techniques usually do not give exactly the type of response desired; thus, some final adjustments to the tuning parameters must be made.

However, you should at least obtain a reasonable starting point from which the desired response characteristics can be obtained.

Controller tuning procedures

There are three procedures for tuning the controller:

- Time, Position, or Current Proportional simplex control,
- Duplex Time or Current Proportional control,
- Two sets of tuning constants for single output operation.

The suggested procedures describe how to establish and store values of Gain(PB), Rate, and Reset time constants for your process. You must know the type of control and algorithm your controller has.

Tuning aids

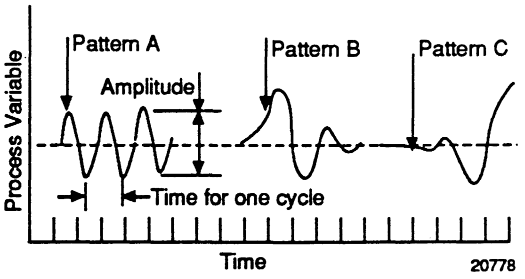
A graphic recorder (such as Honeywell model DPR, DR4500, or VP131) connected to the process variable will make it easier to determine when the oscillations are constant and also the time for one oscillation. If a recorder is not available, you can use a stop watch to time the oscillation of the process variable displayed on the controller.

A.2 Time, Position, or Current Proportional (Simplex) Control

Procedure

The procedure listed in Table A-1 gives you the steps for manually tuning a controller with Time, Position, or Current proportional simplex control.

Table A-1 Manual Tuning Procedure for Simplex Control

Step	Action
1	In Manual Mode, adjust the output to bring the PV (Process Variable) near the desired value.
2	Set the Rate time to 0 minutes and set the Reset time to the maximum value (50.00 minutes) or set repeats/min to the minimum value to minimize reset action If applicable, set the CYCLE TIME to 4 seconds and DEADBAND to 0.5.
3	Increase GAIN (decrease PB) significantly. Try a factor of 10.
4	Adjust the local setpoint to equal PV and switch to Automatic control mode.
5	Increase the setpoint by 5 or 10% and observe the process variable response.
6	If the PV oscillates, continue to step 7. If it does not oscillate, return to the original setpoint and increase GAIN (decrease PB) again by a factor of 2, and repeat step 5.
7	Compare the oscillations with the figure below:  Pattern A Pattern B Pattern C Amplitude Process Variable Time for one cycle Time 20778 • If the oscillation matches pattern A, go to step 8. • If the oscillation matches pattern B, increase GAIN (decrease PB) by a factor of 2 and repeat steps 4 to 6. • If the oscillation matches pattern C, decrease GAIN (increase PB) by a factor of 0.8 and repeat steps 4 to 6 The amplitude of the cycle is immaterial, but all of the elements of the loop must be within the operating range (i.e., the valve must not go full open or closed).
8	Record the current value of GAIN (or PB) and measure and record the value of time for one completed oscillation of PV.

Continued on next page

Procedure, continued

Table A-1 Manual Tuning Procedure for Simplex Control, continued

Step	Action
9	Select the proper set of formulas from Table A-2. Use the values of Gain (or PB) and time (in minutes) in the formulas to arrive at the controller's tuning parameters settings.
A	Enter the values of GAIN (or PB), RATE, and RESET in minutes (or repeats per minute) into the UDC5000 controller and verify that the PV response is adequate. Make additional trimming adjustments, if necessary, to fine tune the controller per the guidelines shown below: TO REDUCE OVERSHOOT Less Gain (more PB) perhaps a longer Rate time. TO INCREASE OVERSHOOT OR INCREASE SPEED OR RESPONSE More Gain (less PB), perhaps shorter Rate time.

Manual tuning formulas Table A-2 lists the formulas used in the procedure listed in Table A-1.

Table A-2 Manual Tuning Formulas

	Units	
	GAIN and RESET TIME in $\frac{\text{Minutes}}{\text{Repeat}}$	% PROPORTIONAL BAND and RESET ACTION in $\frac{\text{Repeats}}{\text{Minutes}}$
Proportional (P) only Use PD+MR Algorithm (i.e. No Reset)	GAIN = Measured Gain x 0.5 RESET TIME = 50.00 (minimum reset) RATE = 0	%PB = Measured PB x 2 RESET ACTION = 0.02 (repeats/minute) RATE = 0
Proportional + Reset (PI) (No Rate)	GAIN = Measured Gain x 0.5 RESET TIME (M/R) = $\frac{\text{Measured Time}}{1.2}$ RATE = 0	%PB = Measured PB x 2.2 RESET ACTION (R/M) = $\frac{1.2}{\text{Measured Time}}$ RATE = 0
Proportional + Reset + Rate (PID)	GAIN = Measured Gain x 0.6 RESET TIME = $\frac{\text{Measured Time}}{2}$ RATE = $\frac{\text{Measured Time}}{8}$	%PB = Measured PB x 1.7 RESET ACTION = $\frac{2}{\text{Measured Time}}$ RATE = $\frac{\text{Measured Time}}{8}$

A.3 Time Proportional Duplex or Current Proportional Duplex Control

Introduction

For HEAT/COOL applications.
Tune the controller with the output above 50% for Heat and below 50% for Cool.

HEAT/COOL prompts

The "TUNING"\function prompts for HEAT/COOL are:

HEAT	COOL
PROP BAND or GAIN	GAIN2
RSETMIN or RSETRPM	RSET2MIN or RSETRPM2
RATEMIN	RATE2MIN
CYCSEC	CYC2SEC

A.4 Two Sets of Tuning Parameters for Single Output Operation

Introduction

You can use two sets of tuning constants for single output types and tune each set separately.

TWO SETS prompts

The “TUNING” function prompts for two sets are:

PID SET 1	PID SET 2
PROP BAND or GAIN	GAIN2
RSETMIN or RSETRPM	RSET2MIN or RSETRPM2
RATEMIN	RATE2MIN
CYCSEC	CYC2SEC

A.5 Two Loops of Control

Introduction

You can use two sets of tuning constants on Loop 2 of a two Loop controller and tune each set separately

Loop 2 prompts

The "TUNING" function prompts for two sets on Loop 2 are:

PID SET 1	PID SET 2
PROP BAND3 or GAIN3	GAIN4
RSET3MIN or RSET3RPM	RSET4MIN or RSET4RPM
RATE3MIN	RATE4MIN
CYC3SEC	CYC4SEC

A.6 Internal Cascade

Introduction

When using two loops a Internal Cascade, tune the secondary loop (Loop 1) first, then tune the primary loop (Loop 2).

Procedure

Table A-3 is a suggested procedure for tuning Cascade Control.

Table A-3 Tuning Cascade Control

Step	Action
1	Place Loop 1 in local setpoint mode [or if left in cascade (RSP) mode, switch Loop 2 to manual mode] so Loop 1's setpoint will not be varying during the tuning of Loop 1.
2	Use "Start-up Mode" (See Subsection 5.16) to tune Loop 1 [alternatively, you could change Loop 1 local setpoint and use "SP ADAPT" to tune Loop 1] After tuning Loop 1, disable Adaptive on Loop 1.
3	Insure Loop 1 is placed in Cascade (RSP) mode and then use "Start-up Mode" to tune the primary loop (Loop 2). Verify that KPG (Process Gain) is set to 1.0 initially.
4	You can either disable Loop 2 tuning, or leave it "Enabled" after tuning.

Appendix B

How to Apply Digital Instrumentation in Severe Electrical Noise Environments

B.1 Overview

Guideline overview

Products that incorporate digital technology provide recognized performance advantages over conventional analog instrumentation used for process control. These advantages can result in better product uniformity and greater overall efficiency when used correctly.

There are, however, certain guidelines regarding installation and wiring which must be carefully followed in order to achieve this performance. In addition to the traditional precaution of the separation of signal and power wiring in separate conduits, other measures must be taken to minimize the effects of electromagnetic interference (EMI) and radio frequency interference (RFI) on the operation of the equipment. Otherwise, if high level, short duration, noise spikes are permitted to enter the digital equipment, the noise can be transferred into the system's logic networks and can be misinterpreted as signal data, resulting in erroneous system operation and other unpredictable responses.

What's in this section

This section contains the following information:

Topic		See Page
B.1	Overview	267
B.2	Potential Noise Sources	268
B.3	Prevention Methods	269
B.4	Recommended Wiring Practices	270
B.5	Power Source Considerations	272
B.6	Noise Suppression at the Source	273

B.2 Potential Noise Sources

Overview

Noise can enter electronic equipment via three methods of coupling, namely:

- Capacitive (or electrostatic)
- Inductive (or magnetic)
- Impedance.

Capacitive and inductive coupling

Capacitive and inductive coupling have the same essential effect — they couple current or voltage, without any actual connection of the two circuits. Impedance coupling requires a connection between the two circuits. Typical noise-generating sources that could affect electronic equipment through capacitive and inductive coupling include:

- Relay coils
- Solenoids
- AC power wires — particularly at or above 100 Vac
- Current carrying cables
- Thyristor field exciters
- Radio frequency transmissions.

Impedance coupled noise

Impedance-coupled noise may enter by way of the lines used to power the digital equipment or by way of improper grounding. Most power lines, at typical industrial locations, are far from noise-free. The noise on them can be generated in many ways, but are nearly always associated with switching circuits of some nature.

These include:

- Large relays
- Contactors
- Motor starters
- Business and industrial machines
- Power tools
- HID (high intensity discharge) lights
- Silicon controlled rectifiers (SCRs) that are phase-angled fired.

B.3 Prevention Methods

Introduction

There are three ways to prevent electrical noise from interfering with the operation of the electronic digital equipment.

- Built-in noise rejection
- Separation of signal and power lines
- Noise suppression at source

Built-in noise rejection

The first method is to design the digital equipment with a high degree of noise rejection built-in. This includes housing the equipment in a case that will provide shielding, liberal use of noise rejection filters and opto-isolators, and the use of noise suppressors on potential noise sources within the equipment itself. This, of course, is the responsibility of the manufacturer who usually performs extensive laboratory and field testing of newly designed digital equipment to insure the adequacy of its immunity to noise. As a minimum requirement, the equipment should be able to pass the tests outlined in the IEEE Standard 472-1974 *(Surge Withstand Capacity Tests).*

Signal and power line separation

The second method is to prevent noise from getting on the signal and power lines that are connected to the equipment. This is achieved by proper separation and shielding of those lines. In some cases, separate power lines or special power line regulation or filtering may be required for satisfactory electronic digital equipment operation. It is the responsibility of the installer to follow good wiring practices.

Suppression at the source

The third prevention method is to suppress the noise at its source. This is the most effective but also the most difficult because it is not easy to identify all of the potential noise sources in a typical industrial installation. Therefore, "suppression" is usually a last resort for those extreme situations where the other methods are insufficient by themselves. See *Noise Suppression at Source* which follows.

B.4 Recommended Wiring Practices

General rules

- All wiring must conform to local codes and practices.
- Wires carrying similar types of signals (Table B-1) may be bundled together, but bundles with different types of signals must be kept separated to prevent inductive or capacitive coupling.

Wire bundling

Table B-1 shows what wiring should be bundled together to prevent inductive or capacitive coupling.

Table B-1 External Wiring

Wire Function		Bundle No.	Are Shielded Twisted Wires Recommended?
No.	Type		
	HIGH VOLTAGE	1	NO
1	Line Power		
2	Earth Ground		
3	Line Voltage Digital I/O		
	ANALOG I/O	2	YES
4	Process Variable RTD Thermocouple dc Millivolts		
5	Low level (<100V) 4-20 mA dc 1-5 Vdc		
	DIGITAL I/O	3	YES
6	Low Voltage (<100V)		
7	Computer Interface		

Continued on next page

Additional rules

Please observe these additional rules for wire bundling:

- For distances over five (5) feet, and when shielding is recommended, use a separate metal tray or conduit for each bundle. Where conduits or trays are not practical, use twisted wires with a metal overbraid and provide physical separation of at least one foot.
- Tray covers must be in continuous contact with the side rails of the trays.
- When unlike signal levels must cross, either in trays or conduits, they should cross at a 90-degree angle and at a maximum spacing. Where it is not possible to provide spacing, a grounded steel barrier or grid should be placed between the unlike levels at the crossover points.
- Trays containing low level wiring should have solid bottoms and sides. Tray covers must be used for complete shielding. Tray cover contact with side rails must be positive and continuous to avoid high reluctance air gaps, which impair shielding. Trays for low level cables should be metal and solidly grounded.
- Wires containing low level signals should not be routed near any of the following:
  - Contactors,
  - Motors,
  - Generators,
  - Radio transmitters, and
  - Wires carrying high current that is being switched on and off.
- Use a 12-gage (or heavier) insulated stranded wire for the ground connection. Attach it firmly to a proven good earth ground such as a metal stake driven into the ground.
- All shields should be grounded at one end only — preferably the instrument end.

B.5 Power Source Considerations

Operate within limits

The AC power for the digital electronic equipment must be within the voltage and frequency limits specified for that equipment. Attempts to operate outside the specified limits will result in no performance. For those installations where the supply voltage will not stay within the specified limits, a ferroresonant transformer, for voltage resolution, should be used.

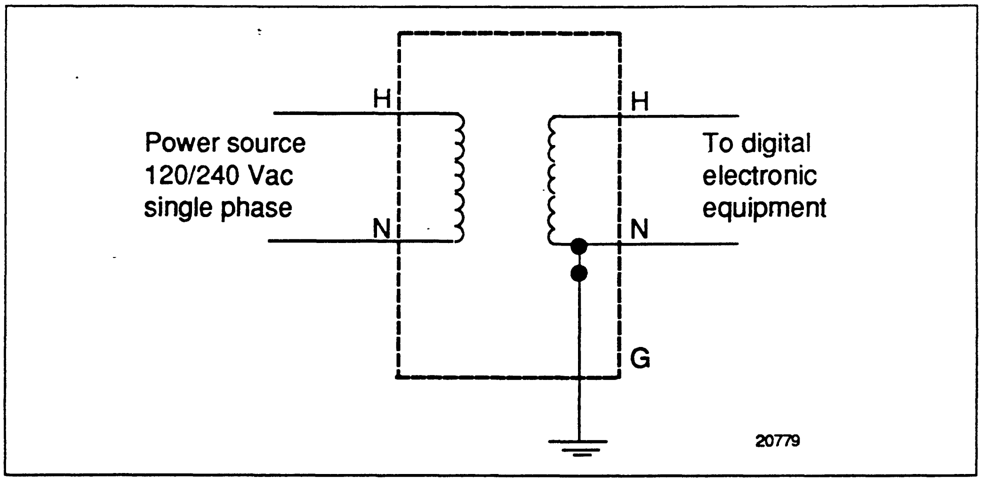
Independent AC source

For protection against noise, the AC source for the digital electronic equipment should be independent of all other loads especially when switching loads are involved. For example, it should not provide power for air-conditioning, convenience outlets, lighting, motors, or similar noise-generating devices. To obtain electrical isolation (see Figure B-1) a separate transformer is required to supply power to the digital equipment. For additional noise and transient rejection, shielded primary and secondary windings may be required. And, if necessary, power line filters may be added to attenuate noise signals that have a higher frequency than the power line frequency.

Transformer for digital equipment

Figure B-1 is an illustration of a separate transformer required to supply power to digital equipment.

Figure B-1 Transformer for Digital Equipment



B.6 Noise Suppression at the Source

Introduction

Generally speaking, when good wiring practices are used with well-designed digital electronic equipment, no further noise protection is necessary. However, in some severe electrical environments, the magnitude of the electrical noise is so great that it must be suppressed at the source. In most control cabinets, the main sources of noise are motor starters, contactors, relays, and switching gear. For this reason, many manufacturers of these devices supply "surge suppressors" which mount directly on the noise source, (for example, on the coil of a control relay or motor starter).

For those devices that do not have accessory "surge suppressors," resistance-capacitance (RC) circuits and/or voltage limiters such as metal varistors may be added when and where needed. This can be broken down into two categories, namely inductive loads (for example, a relay switch in series with a relay coil) and contacts.

Inductive coils

Metal Oxide Varistors (MOVs) are recommended for transient suppression in inductive coils. An MOV is connected in parallel with the coil and is as close as physically possible to the coil (see Figure B-2). MOV devices (listed in Table B-2) are recommended for general purpose applications.

Table B-2 lists part numbers for recommended MOV devices.

Table B-2 MOV Devices

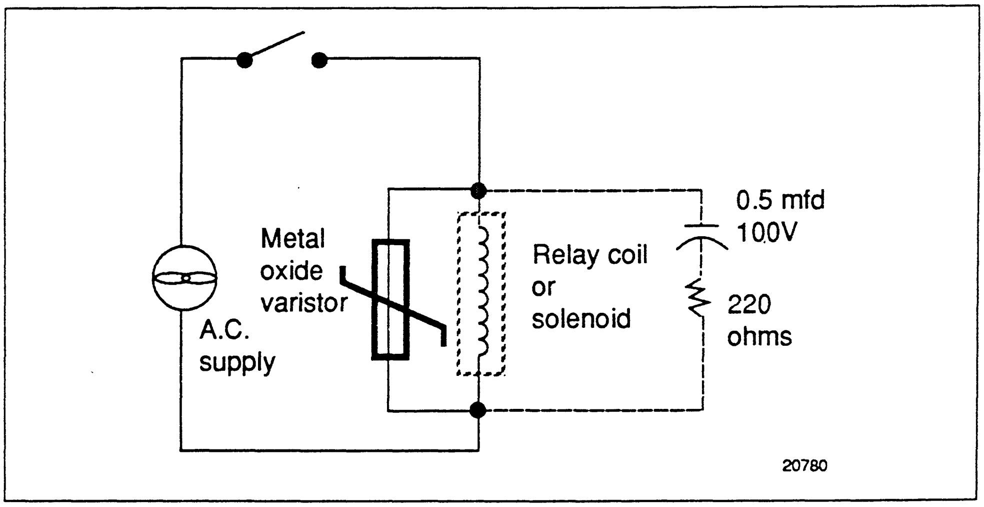
Part Number	30732481-501	30732481-502
Maximum AC	130V	275V
Energy Pulse Rating	10 Joules	15 Joules
Supplier (General Electric)	V130LA10A	V275LA15A

Continued on next page

Inductive coils, continued

Figure B-2 is an illustration of transient suppression in inductive coils.

Figure B-2 Transient Suppression in Inductive Coils



Additional protection may be provided by adding an RC circuit in parallel with the MOV. This consists of a 220-ohm resistor in series with a 0.5 microfarad, 1000V capacitor. The power rating of the resistor will depend on the voltage rating of the coil (see Table B-3).

Table B-3 Coil Voltage vs Resistor Voltage Rating

Coil Voltage	Resistor Voltage Rating
115V	1/4 Watt
230V	1 Watt
460V	3 Watt
550V	5 Watt

Continued on next page

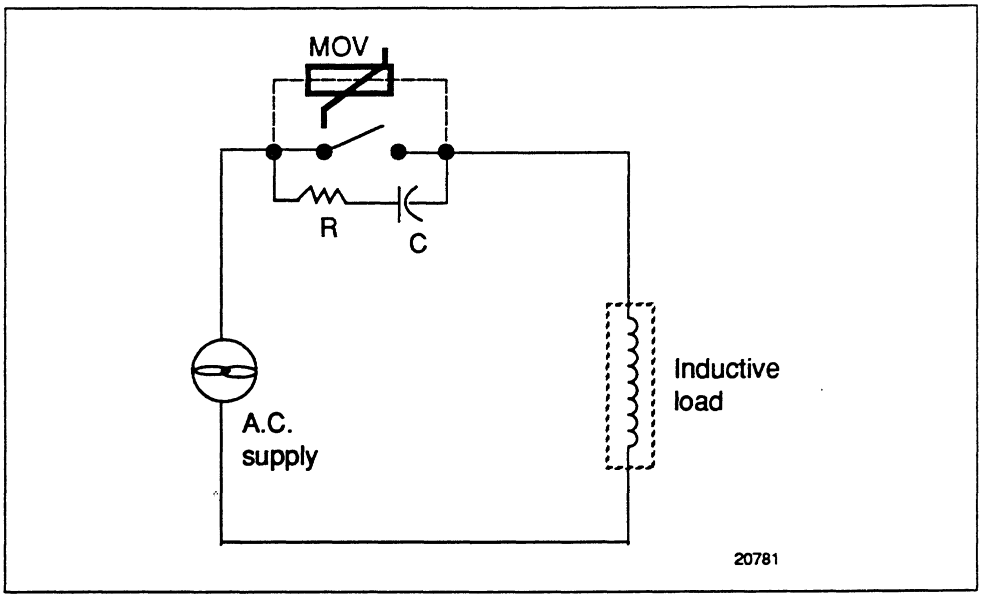
Contacts

When a contact interrupts an inductive load, a certain amount of energy is stored in the load. An MOV or RC circuit in parallel with the load provides a place where this energy may be dissipated. However, if there is no MOV or RC circuit, the energy may create a visible electrical arc across the open contacts. This, in turn, results in electrical noise as well as damage to the contacts.

One way to eliminate this arc is to connect a resistor and capacitor across the contacts (see Figure B-3). A combination of 47 ohms and 0.1 microfarads (1000 Vdc) is recommended for circuits up to 3 amps and 300 Vac. For voltages above 2000 Vac, an MOV across the contact may be added for extra protection.

Figure B-3 is an illustration of a resistor and capacitor connected across a contact to eliminate electrical noise.

Figure B-3 Contact Noise Suppression



For large load currents, a rule of thumb is to size the capacitor so that the number of microfarads equals the number of amperes in the load current, and the resistor has the same resistance value as the load. The objective is to eliminate the visible arc.

Either discreet resistors and capacitors or packaged RC networks may be used. An RC network (47 ohms and 0.1 microfarad) is available from Honeywell as part number 30371852-001. Similar RC networks are available from Electrocube Inc. (part number RG1782-3) and from Industrial Condensor Corporation.

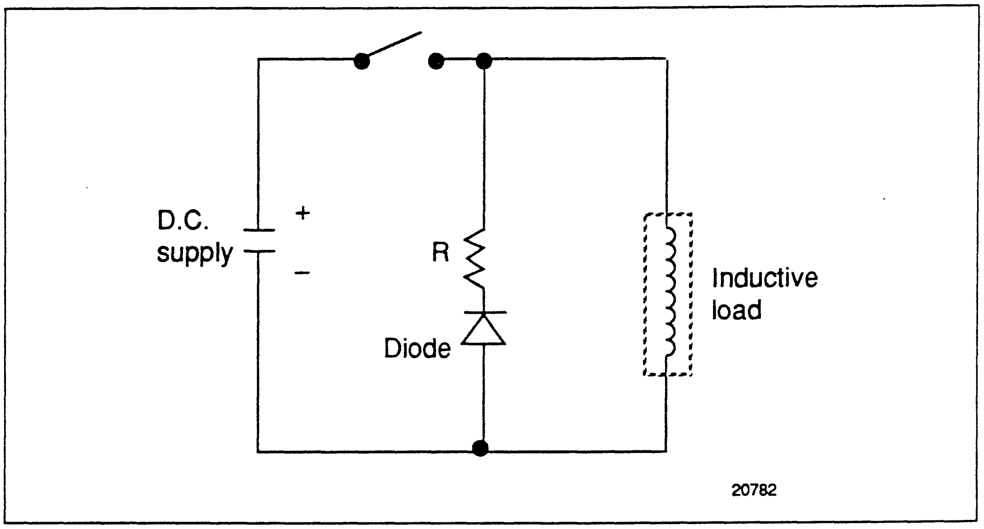
Continued on next page

Contacts, continued

In DC circuits, the power dissipation under steady state condition can be eliminated by placing a diode (in series with a resistor) in parallel with the load (see Figure B-4). The value of R should be less than or equal to the DC resistance of the inductive load.

Figure B-4 is an illustration of DC load noise suppression.

Figure B-4 DC Load Noise Suppression



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